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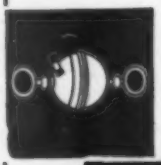

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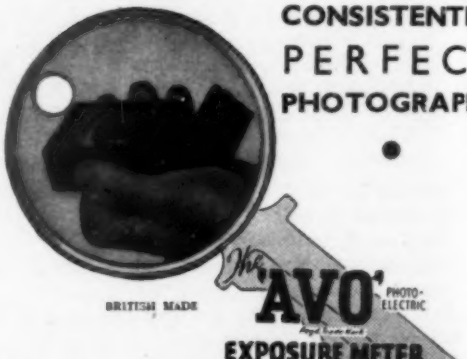

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Science and Society

AT last there are signs, in Great Britain at least, of a rapidly growing awareness of the importance of those complex problems confronting our community, due primarily to the astonishing rate of advance of scientific knowledge during the last generation, a rate which is accelerating even as we study it. Our social outlook and our social institutions toil feebly behind this advance and, lagging as they do, permit the placing of weapons of unparalleled potency for good or evil in the hands of those who may, alas, be unfit to use them. Faced with an annihilation of distance which makes it possible to put a girdle round the earth in a few days, to discuss, as an everyday matter, the possibility of establishing aeroplane factories in Canada for the supply of Britain ; with methods of transport which, thanks to the labours of physicist, engineer and biologist, bring the fruits of the earth in perfect condition from the antipodes to our shores—give us, in Sir William Hardy's words, "Summer all the year round" ; with the knowledge that "the growth and health of children in poor industrial areas and in the homes of many agricultural labourers are still seriously handicapped by protein and vitamin deficiencies", and that "the evidence for this has been fully substantiated by social and dietary surveys" ; men of science must obviously accept a certain amount of responsibility for the solution of problems created by them.

These problems, raised by increase of knowledge, are met by social and economic—what for the use of a better word must be called 'plannings'—which might have been adequate to the needs of an era when a sparsely populated nation could be considered roughly as a self-supporting economic unit ; when national patriotism, itself a plant of comparatively recent growth, was well enough fitted to the age in which it flourished ; when a great man of letters could write of that bloody swathe which the dæmonic energy of Napoleon was cutting across Europe—"this war, of which philosophers take no heed" ; but they are not adequate to-day, when the whole structure of civilized life is in peril. Here are problems of plenty and of deficiency, of war and of peace, which, in the terms of their presentment, are peculiarly the products of our own age—most of them problems which the world has never before been forced to meet. What contribution can the man of science make towards their solution ?

It is a moot point whether he, as a social and political animal, has been greatly influenced by his own scientific outlook. Faraday shut the door of his laboratory when he went into his oratory, and the man of science too often in the past has kept his political and scientific methods completely separate, and has been as much a victim to prejudice as his brother trained in the humanities. It is this tendency to arrive at political and ethical conclusions in terms of emotional reactions rather than rational judgments which makes government an art—the cynic would say, a dodge—rather than a science ; which gives point to the demand for a "World Encyclopædia", recently stressed by Mr. H. G. Wells. It is a hopeful sign that, as was shown in the columns of the last issue of NATURE, so great a mass of considered opinion is so fully awake to the fact that it is worse than useless to meet these problems of our own age, armed with machinery devised to deal with those of the eighteenth and nineteenth centuries.

The correspondence shows a remarkable consensus of opinion. Practically all are agreed that

some organized body is necessary which shall study the problems, many of them highly controversial, evoked by the impact of science on society, in an objective and rational manner. Such a body must have the closest linkings with the physical and biological sciences, with economics, engineering, psychology, anthropology and sociology. It must provide a platform for free and frank debate; it should conduct its investigations as much by means of research committees and discussions as by the formal reading of papers; it should endeavour to make its findings plain to the man in the street.

There can be no question as to the need for such work to be undertaken. The present age is deafened by the cries of advertisers of nostrums of all kinds; and those of us who believe that, before all and above all, reason, and conviction by an appeal to reason, are the indispensable bases for any ordered, successful and permanent social advance, cannot but be alarmed at the growing tendency to explosions of mass-hysteria. It is only when reason provides the outlook that the emotions may be trusted to control the direction. In a society such as is proposed it is of the first importance that its explorations should be conducted and its conclusions reached in a detached and cool spirit. Coolness does not mean cold-bloodedness nor does it connote any hesitation in pursuing the right path once that path is known.

The main problem being one of the interaction of science and social relations, it is clear that, as Prof. Ginsberg has put it, "the study of the effects of science on social relations requires not only a knowledge of science, but also of social relations". The problems are, in fact, sociological, and the society which undertakes the task of studying these repercussions must have a very wide field on which to draw. It may be that the ends in view will best be served by the formation of a new society charged with the special task of surveying and interpreting the social relations of science, but before actually constituting such a society, the British Association, itself a pioneer in the attack on some parts of the problem, might be invited to undertake the task.

As some correspondents have pointed out, the annual meeting of the Association provides an admirable platform from which to announce progress, but that much more than this is needed: and much more is possible. Already the Association is enlarging its activities to meet the changing needs of a changing era. It has initiated, in many of its sections, papers and discussions which touch upon these topics; it has taken part in the jubilee meeting of the Indian Science Congress Association, recently held in Calcutta, thereby establishing an important principle of overseas delegations. At the present moment its general officers are in consultation with their colleagues of the American Association for the Advancement of Science on a scheme for international co-operation such as that Association has recently adumbrated. The Association possesses sections the work of which touches closely that of a society for the study of social relations, and it is second to none in its experience of the manner of work of research committees. Is it too much to suggest that the Association might very well consider the arranging of discussions of these problems to be held in London or elsewhere at regular intervals outside the annual meeting? For the organization of such meetings, and the undertaking of appropriate investigations by research committees, an entirely new department of the Association might be constituted. It seems to us that this plan would be preferable to the addition of a new section, or sub-section, to deal with the social relations of science.

A new society of the kind contemplated implies much more than an annual report; and if the British Association accepted responsibility for its functions, either by the formation of a new department or otherwise, the present annual report would have to be supplemented by a new periodical publication comparable to the proceedings or journals of other societies, and devoted mainly to the advancement of knowledge of the impact of science on society and of society on science.

It may be that the serious questions of finance and of policy involved will make it too difficult for the Association to undertake this work. But in its constitution and outlook it is at least a possible body to undertake such duties, and its long and brilliant traditions are sufficient guarantee that the work, if undertaken, will be carried out in the true spirit of science and of public service. We suggest, therefore, that when a meeting is held to discuss proposals for constituting a body to organize inquiries into the social relations of science and publish the results, the possibility that the Association might accept this responsibility should be considered. Even if the Association fails to do so, for financial or other reasons, it might in many ways assist the work of any new society which may be formed.

The Mandæans

The Mandæans of Iraq and Iran: Their Cults, Customs, Magic, Legends and Folklore. By E. S. Drower ('E. S. Stevens'). Pp. xxvi + 436 + 29 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 25*s.* net.

HITHERTO our knowledge of the Mandæans—a small community of some 5,000 souls dispersed over a few places in Iraq and Iran—has been confined to the writings of Lidzbarski and Brandt, which rested on such scanty texts as had found their way to Europe, and the casual observations of Petermann, who spent three months in 1860 in the marshes of Lower Iraq, and of various other travellers whose curiosity they aroused. The results of these labours were not altogether satisfactory: Petermann's sojourn was too short to give him more than a modest acquaintance with a single community, while the works of Brandt and Lidzbarski suffer from a lack of any knowledge of the people themselves. Mrs. Drower, whose husband held a position as judicial adviser in Iraq, has the double advantage of having been able to familiarize herself with the remains of Mandæan literature and of having been resident in Bagdad since 1922, with ample opportunities of investigating the customs of these interesting people at first hand.

At the beginning of this period, Mrs. Drower was compelled to carry out her work through the medium of Arabic, but since 1931 she set herself to learn also Mandaic, the ancient Aramaic dialect in which the sacred books of the Mandæans are written and their rites carried out, but which is now rapidly dying out in ordinary use; and almost the only regret which the reviewer has is that she is not a trained philologist, as she herself confesses and as some of her transliterations and translations show, since the dialect is linguistically of some interest and Nöldeke's "Mandäische Grammatik" deals only with the language as known in a few published texts.

The Mandæan religion, which is generally regarded as a kind of Jewish gnosticism from the Aramaic *manda*^{e} 'knowledge' (though Mrs. Drower doubts this explanation), whence its name is derived, is based on the ancient worship of the principles of life and fertility, and the symbol of the 'Great Life' is running water—a natural idea in a country which the two great swiftly flowing rivers, the Tigris and the Euphrates, traverse—and it follows from this that the central rite is baptism or rather total immersion in flowing water. The second great life-giving power is light, bestowing health and strength, virtue and justice. The third important element is the doctrine of the immortality of the soul and its close connexion with the souls of its ancestors. From this insistence on 'living', that is running, water is derived one of the two reasons why the Mandæans have such contempt for Christians, inasmuch as these use 'dead' water for their baptisms. The other is the celibacy of their monks and nuns, since the Mandæans regard the procreation of children as a religious duty; indeed, they go so far as to hold that even the most pious Mandæan, if he dies childless, after passing through a state of purgatory and a sojourn in the worlds of light, must return again to a physical state and become a father.

Mrs. Drower offers various conjectures about the origin of the Mandæans and, what is of great interest, tells much of their own traditions. Thus they claim descent from the ancient Egyptians and annually partake of a ritual meal in memory of those Egyptians who perished pursuing the "wicked Jews" across the waters of the Red Sea, while she shows that their doctrine has clear affinities with Mazdæism. A very primitive water-cult seems in fact to lie behind Mandæism, but very diverse elements have been absorbed into it, especially from Babylonian religion and that of the Parsis: for example, the ritual immersion of the priests is probably of Babylonian origin and writing and books are under the charge of the planet *Nbû*, who is none other than the Biblical Nebo (Isaiah xlvi, 1) or Babylonian *Nabû*, the patron deity of scribes, while the ritual meals (apart from certain specific differences) closely resemble those of Indian Parsis. Even the baptism of Adam has become the occasion of an annual feast!

Some Mandæan practices strike the modern reader as strange, if not actually revolting. Thus an expectant mother is removed for her confinement from the house, which she may pollute, to a cattle-shed or store-shed, where she spreads "something soft or without value, such as old clouts" in a corner on the ground and is there delivered; the mother is then immediately, if possible within half an hour, helped down to the river by the midwife and subjected to three complete immersions with the customary prayers; but, if the weather is cold, she may be soused in the place where she is lying. In view of these and the other baptisms and rites which mother and

child undergo, it is scarcely surprising that the Mandæans are not a growing community. The dwindling is helped by the spread of education, which is driving the young people into the towns where, even if they wished it, there are not always adequate facilities for continual baptisms in running water; for the oftener a man is baptized (for example, after marriage, birth, illness, travelling, touching the dead, every conceivable sin, and so on) the better, since "baptism, alms, and good deeds make the perfect Mandæan", and these good deeds include scrupulous performance of death-rites and observance of the cult of the dead. What this may mean may be gathered from the fact that the author herself was present at a single ceremony which lasted eighteen hours! Further, the true Mandæan generally refuses to take any medicine even after going to a European doctor, although he has faith in ointments and does not object to injections; and during a recent cholera outbreak one community refused to drink boiled or chlorinated water on the ground that it was 'dead'.

At the same time the priesthood, which is for the most part hereditary, is being recruited with increasing difficulty, partly because of the high standard of pure Mandæan blood and of freedom from physical blemishes required in the priest, and partly because of the growing difficulty in modern cities of finding an unpolluted foreshore where he may carry out his innumerable baptisms in running water. Further, consecration to the priesthood is no light affair: it can take place only when some pious and aged person of ritually pure and priestly stock is at the point of death, and the consecrated priest can carry out no office until he has performed the ceremony of marriage for another priest; if no priest is willing to get married, the new priest remains isolated until one is found ready and willing to contract a marriage (which is not difficult in a polygamous community) to oblige his colleague. It is, too, a symptom of decay that there has not been 'a head of the people', that is a 'chief priest', who attains that rank automatically on having consecrated five priests, for the last eighty years.

Mrs. Drower has divided her book into two parts, the first containing an account of the life and religion, customs and ceremonies of the people, and the second giving a number of folk-tales which she has taken down from the lips of her informers. The book is an admirable example of the results of field-work undertaken by a competent observer and checked by an adequate control of the literature of the subject; and even though a reader may and indeed will disagree with some of the author's suggestions in the sphere of comparative religion, he can only be grateful that she has gathered such a wealth of information at a moment when the Mandæan religion seems likely to disappear before the inevitable advance of modern civilization. The book will henceforth be indispensable as a corrective to the works of scholars who have written on the same subject without ever having set foot outside Europe.

G. R. DRIVER.

Science at Large

Obsessions and Convictions of the Human Intellect

By F. W. Westaway. Pp. xvi + 528 + 4 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 10*s*. 6*d*. net.

THE plan of Mr. Westaway's book is ambitious. It is difficult to give adequate treatment to so large a number of subjects within the compass of a single volume, even of 500 pages. It is not merely that the topics are so numerous; they are so diverse. Thus Mr. Westaway not only introduces us to what may be termed pre-science, like astrology and alchemy, but also to modern forms of pseudo-science, such as palmistry, phrenology and so on. He deals, too, with witchcraft (showing that one may be thankful for some changes that science has wrought in human mentality), with squaring the circle and the history of π, with perpetual motion devices, as well as with theories of a fourth dimension. There follows a chapter on space and time and the idea of infinity, and one on scientific method. We are then conducted through the biological sciences, and afterwards into the realms of metaphysics and theology.

The volume is certainly one to be placed in a school library, and should help to give young science students (and even their teachers) the synoptic view which is in danger of being destroyed by too much specialization. The preface shows that Mr. Westaway is interested in the mental outlook of sixth forms, and perhaps the intelligent senior schoolboy would be the kind of individual to profit most from this book, which incidentally is not superficial though it is popular. Each chapter has a good bibliography. Perhaps the chapters on the physical sciences are the best in the book, but the early chapters, being so full of

unusual material, are highly interesting. When the author approaches the biological sciences, he writes with a refreshing absence of dogmatism. "We certainly still are profoundly ignorant of the real nature of either life, consciousness, or personality."

In approaching metaphysics, Mr. Westaway treats the subject without condescension, as being worthy of serious study. It is certainly good for science students to realize what difficult problems arise out of their own most familiar experiences, as well as out of the methods which they employ in their researches. The theological chapters attempt to make available some of the results of recent historical inquiry, as well as of the critical study of the New Testament. Though the scope of the book is already so wide, one could wish that a discussion of art as well as of religion had been included. Some acquaintance with the philosophy of art is calculated to widen the outlook of the scientific specialist even more, perhaps, than the study of religion (and the practice of art is no less valuable than the practice of religion). In art there are few vested interests in dogma such as those which are apt to deflect the scientific worker's interest from religion. But Mr. Westaway has been so generous that to ask for more seems out of place.

J. C. H.

Geographical and Economic Survey of Great Britain

The British Isles:
a Geographic and Economic Survey. By Dr. L. Dudley Stamp and Stanley H. Beaver. With Contributions by Sir Josiah Stamp and Dr. D. K. Smee. Second edition, revised throughout. Pp. xii + 719. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 25*s*. net.

IN his preface to "Britain and the British Seas" Mr. (now Sir Halford) Mackinder wrote: "Britain is . . . known in such detail that it has been possible to attempt a complete geographical synthesis." In the thirty-five years that have passed since that work was published nothing has appeared to take its place. At the same time much work has been done on these Islands and one has only to glance at the references at the end of the chapters in the present volume to see to what extent Dr. Stamp and Mr. Beaver have been able to draw on the achievements of their fellow geographers spread over a period which has seen both the consolidation of geographical research in Britain and the vindication of the principles propounded in "Britain and the British Seas".

Between the appearance of this latter work and that under review, three books of importance to geographers have been published. The first volume of "The Oxford Survey of the British Empire" (1914) is most closely comparable to the present work in that it consists of a series of studies of aspects of the British Isles by acknowledged experts. M. Demangeon's "Les Iles Britannique" (1927) is an excellent representative of the French 'school' of regional geography, while the volume of "Essays" edited by Prof. A. G. Ogilvie (1928) treats in detail but with varied emphasis regions in Great Britain the boundaries of which were somewhat arbitrarily determined. The present work deals with these Islands in greater detail than any of the others, and the fact that a second edition has been called for within four years of its original publication is a tribute to its usefulness. It has become a standard text-book the general accuracy of which is vouched for by the co-operation of no fewer than nineteen "experts in many of the various fields covered". For this reason, if for no other, it will probably long maintain its place as a valuable work of reference.

Yet herein lies its weakness. What is wanted is a new 'geographical synthesis'. Dr. Stamp admits to, and this book reveals, a passion for facts. Facts are necessary, but facts alone cannot make geography: without vision, geographers must perish. This lack of vision is shown both in the general arrangement of the book and in the unevenness of its various chapters, some of which are long and valuable essays embodying much research while others are mere paraphrases, sometimes scarcely adequate, of the work of others. When the next edition is called for, is it too much to ask that the authors will indicate by way of summary or synthesis what is the hope that is in them—they quote from "Cavalcade"—and wherein is to be found the "dignity and greatness and peace" of Britain? Is it to be found in the use of the land or of "National Capital"? Or rather, is it not to be found in the part which the resources, and their use, will enable the British people to play in world affairs?

To come to narrower limits, it would be of advantage to think out the modern counterpart of Sir Halford Mackinder's 'metropolitan' and 'industrial' England. In this book, one is confronted with thirteen 'industrial regions' in Britain; twenty-five 'agricultural regions', with many sub-divisions, based to some extent on the

'Highland' and 'Lowland' zones; a different set of nineteen 'physiographic and structural units' based on the same zones; and a suggestion in Fig. 234 that, from the point of view of population density there are three divisions which "correspond roughly with industrial, good agricultural, and poor agricultural tracts". With all these ingredients could there not be a consideration of geographical regions? Or is geography to concern itself only with the distribution of different facts? Now that the authors have drawn upon the specialists, one is confident that they could undertake this formidable task. If they do they could then call the next edition of this book "The Geography of the British Isles".

J. N. L. B.

Progress in Enzyme Chemistry

Ergebnisse der Enzymforschung
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 7. Pp. xiv + 437. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 34 gold marks.

THIS year's volume follows the now well-known lines: it is substantially larger, perhaps indicating the intense interest in the subject. With one exception, the articles are in English or German; that on sulfatases by Cl. Fromageot is in French. As usual they cover selected sections of experimental activity which can conveniently be summarized at this moment.

Pride of place may be claimed for M. L. Anson's brief note on crystalline carboxypeptidase, a long name for a pancreatic enzyme which, however, is explicit as to the action it performs. The enzymes are now largely regarded as proteins, so that it is a question of finding out the right conditions for their isolation, when the further investigation of their structure can go hand in hand with that of the proteins. Interposing, the view may be expressed that this particular problem of protein structure is not being attacked with all the forces that its importance indicates. Anson stresses the extreme difference in the protein properties of the various enzyme proteins, which have so far contributed to prevent their isolation by standardized systematic procedures. It is clear now that ordinary cells contain a multiplicity of proteins and that the specific properties of these serve to control many of the chemical reactions which take place in living cells. The control exercised by varying the stereochemical configuration of such a relatively simple substance as glucose has been often stressed; obviously with the complex proteins the possibilities of variation are infinitely more numerous.

Next in significance may be placed the story by H. Raistrick of some aspects of the biochemistry of the lower fungi, which indicate certain relationships in structure between the large number of mould metabolic products. The interesting conclusion is expressed that one of the first stages in the life of most fungi is that of synthesis of a complex polysaccharide from the nutrient available in the same way that starch is a primary product of synthesis in the green plant. At a later stage this polysaccharide is broken down in a variety of ways, giving rise to the characteristic products of the individual race. Renewed interest is at once attached to such polysaccharides and to their structure—four new ones are described.

The question of the relation of specificity to chemical structure continues to promote investigation. It is the basis of a well-compiled report on immunochemistry and its relation to enzymes by J. Marrack, as well as the article on emulsin by B. Helferich, who has long been the protagonist for ascribing a wide range of activity to this enzyme rather than regarding it as a mixture. His arguments are not altogether convincing. A new point of importance here is the hint that the tryptophane unit in emulsin has a role in its activity.

The knowledge of the group of ferments which breaks down the nucleic acids has progressed to a satisfactory stage and it is valuable to have a crisp summary of these nucleases compiled by H. Bredereck.

Among the more difficult articles is one from the pen of Otto Warburg on the chemical constitution of the enzymes, a question to which an answer is anxiously awaited. The treatment is largely mathematical and concerns the relation between the metallic prosthetic group and the conjugated protein for certain oxidizing and reducing enzymes.

The technical article this year concerns the part played by enzymes in the tanning industry; it is written by F. Schneider and covers a wide field in forty pages. Of technical interest also is a summary of the biochemistry of acetic acid bacteria which indicates all the more recent observations.

The examples selected suffice to show the wide range of subjects covered and the utility of the "Ergebnisse" in these days when it has become impossible to keep up with the original literature.

E. F. A.

Leçons d'algèbre et de géométrie à l'usage des étudiants des Facultés des Sciences
Par Prof. René Garnier. (Cours de la Faculté des Sciences de Paris.) D'après la rédaction de Badrig Guèndjian. Tome 3 : Élimination, éléments de géométrie réglée, transformation de Lie, applications à la géométrie conforme. Pp. vi+280. (Paris : Gauthier-Villars, 1937.) 80 francs.

THIS is the third volume of a series of "Leçons d'algèbre et de géométrie" written by Prof. Garnier for the use of students in the Faculty of Science at Paris.

The subject-matter in the present volume should appeal to the analyst who desires to study some higher geometry by his own favourite methods. The course starts with a chapter on algebraic equations, and consists of two main sections devoted respectively to symmetric functions and elimination. This provides a foundation for the remaining part, which deals, in seven chapters, with higher geometrical conceptions treated algebraically. The notion of a locus is first carefully developed and extended to conoidal surfaces as well as to those of revolution. Then follow chapters on Plücker's line co-ordinates, the linear complex, the tetrahedral complex, Lie's transformation, in which is included a discussion of pentaspherical co-ordinates, and an application of the transformation to curvature. Parts of the text are amplified in four short notes and additions given at the end.

The text is clearly written with great care and precision, and is quite easy to follow in spite of the fact that the subject-matter is by no means of an elementary character. There are, as usual in many French mathematical text-books, no exercises, but the whole course is both interesting and stimulating.

F. G. W. B.

Das Sammeln, Konservieren und Aufstellen von Wirbeltieren:
Leitfaden für Sammler, Liebhaber und Fachleute nach neuzeitlichen Gesichtspunkten. Von Gerhard Schröder. Pp. viii+93+32 plates. (Berlin : Paul Parey, 1936.) 4.80 gold marks.

SO far as precept, in place of the experience of watching a taxidermist at work, can instil methods of preserving and mounting vertebrate animals, this little book by the taxidermist of the zoological museum in the University of Berlin is a useful guide for collectors and amateurs. It describes the methods of skinning birds and mammals, the mounting of birds' skins, and the making of models and plaster casts of the larger mammals in the modern method for use as the foundation of the final mount.

The progressive stages of these processes are well illustrated by photographic reproductions. Plaster and paraffin moulds are recommended for fishes and reptiles, but no mention is made of the celluloid coatings which have proved so life-like in the construction of reptilian models in some American museums. Hints are given regarding the construction of large habitat groups.

Descartes' Discourse on Method
By Prof. Leon Roth. Pp. viii+142. (Oxford : Clarendon Press ; London : Oxford University Press, 1937.) 6*s*. net.

THE year 1936 marked the tricentenary of Descartes' "Discourse on Method", so Prof. Roth's study is both timely and welcome. A turning point in European thought, the "Discourse" has a story of its own, which is carefully recounted : we are shown that if it is formally true to look upon it as the introduction to Descartes' philosophy, this short work is materially a retrospect, a summing-up of a life's achievement, rather than the laying down of a programme ; hence its primary importance for the understanding of Cartesian philosophy.

The method proposed by Descartes is typical of philosophical rationalism : the rule of 'division' and of the unilateral 'order' is its keynote. But the method itself proved to be inadequate to Descartes' purpose, which was to substitute a physics based on metaphysics for a metaphysics based on physics, and to treat physics as a part of mathematics. The linking of the "Method" with physics proved to be disastrous. Their dissociation, effected by Descartes' critics, saved his philosophy from a total eclipse. Thus, Cartesianism has survived, not as a system of physics or metaphysics, but as a general method of analysis.

In estimating the nature and fate of Cartesianism, Prof. Roth is thus led to discuss the whole problem of the value of the mathematical outlook and the general competence of the mathematical mind. His excellent study may be considered as a lucid introduction to the history and problems of modern thought.

T. G.

Introduction to Mathematical Probability
By Prof. J. V. Uspensky. Pp. ix+411. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 30*s*.

PROF. USPENSKY'S treatise on mathematical probability is a very comprehensive one and includes every theoretical aspect of the subject, with several chapters on modern developments. Only those investigations in theory which touch the philosophical borderline and researches such as those of Reichenbach concerning possible connexions with the polyvalent logical systems, are not reviewed. Chapters i–xii of the work do not presuppose any advanced mathematical knowledge, while Chapters xiii–xvi present all the chief results of modern investigations. There are three appendixes to the book, in one of which an outline of the famous Tsebysheff-Markoff method of moments applied to the proof of the fundamental theorem previously established by another method in Chapter xiv is given.

Problems are appended to every chapter, and for an advanced student there could not be a more admirable text-book from the purely mathematical and theoretical point of view. For just as no philosophical discussions are included, neither does the book go into any of the applications of probability to other sciences.

The Pragmatic and the Dogmatic Spirit in Physics

By Prof. J. Stark, President of the Physikalisch-Technischen Reichanstalt, Berlin-Charlottenburg

THE aim of physical science is the investigation and formulation of the laws which govern the properties and processes observed with objects of inanimate Nature. These inherent laws are independent of human existence, action, and thought, and are the same all over the world. For this reason, the object of physical science is international. But the manner in which physical research is carried out and described depends on the spirit and character of the men of science engaged upon it, and this spirit and character differ individually, as do men, nations and races.

When in what follows I speak of two principal types of mentality in physics, my observations are founded on experience. I have inquired into the mental characteristics that have led the great physicists of the past to their discoveries, and in the course of the forty years of my scientific life I have observed very many more or less successful contemporary physicists and authors of theories and of books, in an endeavour to discern the mainspring of their work. On the basis of this wide experience I have come to recognize that there are two main types of mental attitude among workers in the field of physics.

The pragmatic spirit, from which have sprung the creations of successful discoverers both past and present, is directed towards reality; its aim is to ascertain the laws governing already known phenomena and to discover new phenomena and bodies as yet unknown. Even before they tackle a particular problem, physicists of this school of thought have acquired a certain feeling of the reality of the phenomena to be investigated, by giving careful attention to all previously ascertained facts connected with their problem. On the basis of this feeling they form a conception as to what the body or process to be investigated may be like in reality. For them, however, such a conception is solely the means to the end of devising experimental arrangements for the empirical formulation of their question to reality itself. If the observations made with the apparatus chosen do not confirm the initial conception, as very frequently happens, they reject it without hesitation and seek stimulation from experience for a new conception for the purpose of new experiments. Their final goal is always to establish reality, whether they gain new knowledge or are led to obscure and still unexplored features of the phenomena investigated. The mathematically formulated theory is to physicists of the pragmatic spirit not an end in itself, but solely a method for the purpose either of presenting the knowledge gained from experience in a quantitative manner and as briefly and simply as possible, or of deriving mathematically for special cases results which follow from general laws obtained from experiment.

The physicist of the dogmatic school operates in quite a different manner in the field of physics. He starts out from ideas that have arisen primarily in his own brain, or from arbitrary definitions of relationships between symbols to which a general and so also a physical significance can be ascribed. By logical and mathematical operations he combines them and so derives results in the form of mathematical formulæ. He then seeks to give these a physical meaning by applying them to the results of experience. In so far as they are found to be in accord with experience, he underlines this agreement with the greatest of emphasis, and makes it appear as though the results of experience have been established and have gained scientific importance only by virtue of his theory. If there are any experimental results available that are not embraced by this theory or which stand in contradiction to it, he doubts their validity or considers them so unimportant that he does not deign to mention them. Dogmatic physicists further present things as though their theories and formulæ exhaustively covered the whole range of phenomena treated by them; they can see no further problems in this field, and thought and inquiry are ice-bound in their formulæ.

The aim of the pragmatic spirit is reality, and his way to this goal is appropriate and careful observation; the goal of the dogmatic spirit is the dogmatic formula, and his way is one of logical mathematical construction. For the pragmatic spirit physical research is a process of evolution from what has been established to new experimental knowledge; for him there is no such thing as classical physics or modern physics, but only physics. For the dogmatic spirit physics is a field for his logical formalistic activity towards revolution against existing principles and towards the accomplishment of general acceptance of his theories or, indeed, of his new 'world-picture' (*Weltbild*). The pragmatic spirit advances

continuously to new discoveries and new knowledge; the dogmatic spirit leads to the crippling of experimental research, and to a literature which is as effusive as it is unfruitful and tedious, intrinsically akin to the theological dogmatism of the Middle Ages, which was opposed to the introduction of pragmatic natural science.

The researches of Lenard and of Rutherford present us with obvious recent examples of the manner in which the pragmatic spirit works in physics. By his experimental investigations on cathode rays, Lenard paved the way for the greatest discovery of the last fifty years, that of the electron, and furthermore, in the photo-electric effect, he revealed by careful measurements the connexion between the electron and light. From his intuitive sense of reality and by convincing experiments and measurements, Rutherford derived our knowledge of the radioactive transformation of chemical atoms and of their nuclear structure, knowledge which could never have been derived by dogmatic methods. The relativistic theories of Einstein, which are based on an arbitrary definition of space and time co-ordinates or their differentials, constitute an equally obvious example of a product of the dogmatic spirit. Another example of this kind is the wave-mechanical theory of Schrödinger. By an amazing feat of physico-mathematical acrobatics he obtains as a final result first a differential equation. He then asks what sort of physical significance the function that occurs in his equation may have, and for this he makes a suggestion, according to which the electron is arbitrarily smeared in a large spatial region round about the atom. In characteristic fashion, however, other dogmatic physicists (Born, Jordan, Heisenberg, Sommerfeld) give to the Schrödinger function another dogmatic significance, contrary to fundamental laws of experience. They make the electron dance round the atom in an irregular manner, and allow it to act externally as though it were simultaneously present at every point round about the atom with a charge corresponding to the statistical duration of its sojourn at each point.

There is still another important difference between the pragmatist and the dogmatist in physics, which has to do more with the characters of these two types. The physicist of the pragmatic spirit does not conduct propaganda for the results of his research in order to gain authority and influence; he finds his satisfaction in obtaining new knowledge and trusts that it will receive recognition from the expert as a representation of reality, and that it will serve as a step towards new advances. How different are the protagonists of the dogmatic spirit! They do not first wait for at least five years to see whether their revolutionary fashioned theories may perhaps prove to be inadequate or erroneous when examined in the light of experience. On the contrary, almost before they have been published, a flood of propaganda for them is started by articles in journals and newspapers, by text-books and by lecture tours, if possible right round the world. So far as I am aware, Rutherford never undertook lecture tours to make known the results of his researches. Of Lenard I know that he detested speaking about his researches before a wide public, and that he only twice took part in the German Congress of Natural Science (*Naturforscherversammlung*). On the other hand, older physicists will probably still remember with what pertinacity propaganda was carried on all over the world and before the widest public for Einstein's theories of relativity. Matters have not been quite so bad with the newer dogmatic theories which have been advertised under such terms as quantum theories, quantum mechanics, and so on; nevertheless, for the purpose of propaganda on their behalf, innumerable lectures have been held throughout the world, and very many text-books have been written about them.

In so far as the task of physics is the investigation of bodies and of laws concerning the reality of Nature, only the pragmatic attitude of men of science is qualified to solve them, and hence also alone entitled to do so. When the dogmatic spirit does not confine itself to theology and sociology, but also chooses physics as an arena for its intellectual gymnastics, one might tolerate this, but only under the condition that physical research of the pragmatic school of thought does not suffer in consequence. But for about three decades this condition has not been satisfied, at any rate not in Germany, where during this time the representatives of the dogmatic spirit have gained a dominating influence. By their collective action and their connexion with earlier Ministries they were able to acquire numerous chairs in physics, and above all in theoretical physics. In consequence of this, and because of the lively propaganda for modern dogmatic theories, academic youth was predominantly educated in the scientific ideal of the dogmatic spirit. Not men like Lenard and Rutherford, but Einstein and his dogmatic imitators were held up to them as models for scientific thought and work. I have taken the field against the dogmatic spirit in Germany because I have been able to observe repeatedly its crippling and damaging effect on the development of physical research in this country. In this conflict I have also directed my efforts against the damaging influence of Jews in German science, because I regard them as the chief exponents and propagandists of the dogmatic spirit.

This reference brings me to the national aspects of the mental outlook of men of science in research. It can be adduced from the history of physics that the founders of research in physics, and the great discoverers from Galileo and Newton to the physical pioneers of our own time, were almost exclusively Aryans, predominantly of the Nordic race. From this we may conclude that the predisposition towards pragmatic thinking occurs most frequently in men of the Nordic race. If we examine the originators, representatives and propagandists of modern dogmatic theories, we find amongst them a preponderance of men of Jewish descent. If we remember, in addition, that Jews played a decisive part in the foundation of theological dogmatism, and that the authors and propagandists of Marxian and communistic dogmas are for the most part Jews, we must establish and recognize the fact that the natural inclination to dogmatic thought appears with especial frequency in people of Jewish origin.

In establishing these facts, of course, I do not maintain that there are no Aryan men of science who are actively engaged in the dogmatic spirit in the realm of science; nor do I maintain that Jews cannot produce valuable experimental work carried out in the pragmatic spirit. I wish solely to make a statement on the frequency of occurrence of the natural tendency to pragmatic or to dogmatic ways of thinking. It must also be taken into consideration that, by training and practice, Aryans can become accustomed to the dogmatic and Jews to the pragmatic habits of thought. I acknowledge scientific achievement in new discoveries irrespective of the nationality of the discoverer, and I combat the harmful influence of the dogmatic spirit in physics whenever I encounter it in my scientific work, and regardless of whether the culprit is a Jew or not. Moreover, I have been engaged in this fight not only since 1933, for as long ago as the year 1922 I denounced in the strongest terms the formalism and dogmatism in German physics in one of my publications entitled: "The Present Crisis in German Physics".

Problems in the Oceanography of the North Atlantic

By C. O'D. Iselin, Woods Hole Oceanographic Institution, Woods Hole, Mass.

PROGRESS in our understanding of ocean circulation has generally been even slower than in some of the other branches of oceanography, in spite of the fact that in nearly every marine problem, both biological and physical, the current system plays a basic part.

At first the study of ocean currents was held back by the lack of accurate and convenient instruments. In more recent times, the expense of securing the observations has delayed the accumulation of adequate subsurface data on the distribution of temperature and salinity. If this were known in sufficient detail, it would probably not be a difficult task to settle several of the main problems which now confront physical oceanographers.

In particular, physical oceanographers have been unable to supply the climatologists and fisheries experts with the much-needed data on the variability of oceanic currents. Do ocean currents transport about the same amount of heat year after year, and are they, therefore, unimportant from the point of view of long-range weather forecasting? It is now known that changes in oceanic circulation have, on occasions, affected the fisheries of Great Britain; but it is not yet known if fluctuations in the strength of the Gulf Stream off the American coast bear any relation to fluctuations in the circulation of the water masses off the European coast.[1] Not only are such questions of considerable economic importance in some parts of the world, but also if the answers were known, it would be much easier to secure the necessary financial support to develop fully the science of oceanography.

For these reasons it is very encouraging that arrangements have been made during the past year for a co-operative programme of broad scope. The programme is to be undertaken jointly by the Bermuda Oceanographical Committee of the Royal Society and by the Woods Hole Oceanographic Institution. The Royal Society has obtained a generous grant from the British Government for the promotion of the scheme, and the Bermuda Biological Station is being developed as a base for the oceanographic work. The plan, which will shortly be in actual operation, involves the co-operation of the American oceanographers with the now increased staff of the Bermuda Biological Station; and the British grant, which covers a five-year period, also provides the Station with a much-needed research vessel.

The programme which has been suggested and on which work has already begun (June 1937) is essentially a continuation of modern oceanographic development, but it is hoped that it will be

possible to stress those aspects of the investigation which now seem most likely to lead to the solution of the practical problems outlined above.

Three somewhat conflicting theories have been put forward to explain the mechanism whereby the changes in strength of the Gulf Stream could influence the fisheries of north-western Europe. The earliest and most popularly accepted belief concerning the influence of the Gulf Stream has the merit of logic and simplicity, but it is by no means certain that it is correct. This theory assumes that the Gulf Stream resembles a river of warm, saline water flowing north-eastward from the Florida Straits towards northern Europe, and that the current is variable. Thus, during years when it is stronger than normal, more warm water reaches the European coast to modify the climate and to alter the survival rate of young fish or to change the feeding grounds of the adults. In the light of recent oceanographic investigations, however, it is now known that the Gulf Stream bears little resemblance to a river of warm water. In fact, even off the American coast, only a very small part of the current is warmer than the surrounding seas, and after the current turns eastward and has passed the Grand Banks, the slight temperature maximum at the surface quickly disappears. For this reason, it now seems likely that only if the current changes very greatly in strength from year to year (and no sufficiently marked fluctuations have yet been observed) could it so directly cause a noticeable variation in the European coastal waters. Nevertheless, as will be explained later, the primary observations of the new project will attempt to follow the changes in strength of the Gulf Stream as it flows between Bermuda and the American coast during the next five years.

A second theory, which minimizes the importance of the Gulf Stream's influence on European waters, has been advanced more recently by Le Danois[3], a French oceanographer. He has pointed out that, on the whole, the North Atlantic Ocean can be subdivided into two great contrasting masses of water and that these do not readily mix. South of a line extending roughly from the Færoe Islands to the southern tail of the Grand Banks there is found a superficial, wedge-shaped layer of relatively warm and saline water which increases in thickness to 1,000 metres or more in lower latitudes. To the north at all depths, and elsewhere below the warm layer, is found a much greater mass of cold water of low salinity. Le Danois believes that the northern boundary at the surface between these two contrasting masses changes its location, depending either on variations in the volume of the warm layer or on a north-south shift of its mean position. An expansion or northward movement of the warm layer is termed a transgression and the opposite movement, a regression. Since the northern boundary of the warm layer is inclined towards the north-east, Le Danois believes that the main strength of a transgression is also expended in this direction and, therefore, that periodic variations are produced in the temperature and salinity of European coastal waters. He has collected evidence to support his theory that the transgressions come in cycles of increasing intensity having periods of 1, 4·6, 9·3, 18·6 and 111 years. Thus he has suggested that the periodicity is controlled by astronomical forces.

With some of the details of Le Danois' theory many oceanographers cannot agree, and especially they have ample evidence that the continuation of the Gulf Stream, better called the North Atlantic Current, cannot be disregarded. However, the northern branch of this current on the whole marks the northern limit of relatively warm water at the surface, and the main pattern of horizontal circulation in the North Atlantic is undoubtedly a huge clockwise eddy. Therefore, if the warm water at the centre of the eddy should increase in volume, or should its axis shift northward, the effect would be comparable to Le Danois' transgression theory. In other words, there is a possibility that changes in the amount or position of the warm-water core around which the North Atlantic eddy revolves and which it can be thought of as confining, may occasionally displace the current system of the north-eastern North Atlantic and thus cause marked and widespread variations near the European shore.

On the other hand, there is also the other possibility that the warm surface layer has a relatively constant volume and position, and this leads us through modern oceanographic principles to a newer theory that at the present time seems to have few drawbacks.

If we assume, as most investigators do, that the greater part of the energy which maintains the North Atlantic eddy comes from the trade winds, and if these should vary in strength from year to year, then the Gulf Stream, which is the most spectacular part of the eddy, would also vary in transport. If the current should increase, the Bjerknes[3] principle demands that the thickness of the central mass of warm water (the Sargasso Sea) should also increase. Therefore, unless the amount of warm water also increases, the diameter of the eddy must contract. In the same way, if the anticyclonic currents weaken, the dynamic height near Bermuda must decrease, which is another way of saying that the warm layer must become thinner. If this occurs, either the eddy must increase in diameter, or warm water must be discharged beyond the outer boundary of the surrounding circulation.

This line of reasoning leads to the idea that during periods of increasing strength of the Gulf Stream, the seas off the coast of Europe will become colder, instead of warmer, and that the reverse will happen during periods of decreasing oceanic circulation. This, of course, is exactly the opposite to the popularly accepted view. Since Bermuda is at approximately the centre of the main eddy of the North Atlantic, the new research vessel will easily be able to follow any changes in the thickness of the warm superficial layer. It can be confidently expected that as soon as this has been done over a period of a few years, it can then be shown which of these possibilities is correct.

Besides these supposed mechanisms involving variations in the intensity of the main horizontal currents, and expansions and contractions of the warm superficial layer of mid-latitudes, another basic theory has often been advanced. In this, the winds across the latitudes between the Grand Banks and northern Europe are considered the primary variable. If the surface water moves in the same direction as the wind, surface temperatures at a given point will rise during periods when southerly winds prevail and will fall with prolonged northerly winds.

Investigators, however, who are convinced by the theoretical studies of Ekman[4], which demand a net transport of the surface layer in a direction 90° to the right of the wind (for the northern hemisphere), will claim that it is easterly winds which cause increasing surface temperatures off the European coast. However this may be, it is clear that, provided the wind is sufficiently variable from year to year, wind currents in the surface layer can strongly influence surface temperatures. In fact, good arguments can be advanced to show that the variations in the strength and direction of the winds are a much more likely cause of changes in the European coastal waters than possible fluctuations of the oceanic circulation.

For the reasons outlined above, the programme of observations now being carried out in the neighbourhood of Bermuda and in the Gulf Stream involves two main investigations. First, the variability of the Gulf Stream will be examined with as much thoroughness as the available facilities permit, and secondly a detailed study of wind-produced movements in the surface layer will be made. In the Gulf Stream investigation the research vessel *Atlantis* of the Woods Hole Oceanographic Institution will play the leading part, while the smaller ship soon to be sent out to Bermuda, the *Culver*, will be chiefly engaged in examining the frictional effect of the wind on the sea surface. In addition, as already mentioned, she will make periodic observations to follow the changes in the thickness of the warm layer covering the central part of the Sargasso Sea. It is hoped that this dual programme will help to answer the question whether local winds or remote currents or a combination of the two are responsible for the variations in the physical characteristics of European coastal waters.

It may be of interest to discuss here some of the details of this five-year programme of observations. We will consider first the work the *Atlantis* began last June in the Gulf Stream. This current is so powerful and wide that an investigator with a single ship at his disposal is forced to use mainly indirect methods, for the technique of current-meter observations in deep water still remains unsatisfactory and time consuming. However, it cannot be stressed too strongly that the indirect methods should be supplemented as often as is practicable by direct observations of the strength of the current. The most reliable indirect method of measuring the volume of such a current as the Gulf Stream is to observe the vertical distribution of temperature and salinity at a number of stations spaced about twenty miles apart on a line crossing the current at right angles. From these observations the distribution of density can be calculated, and by applying the formula of Bjerknes the velocity and volume can be computed. While this method involves certain assumptions, on the soundness of which not all oceanographers are agreed, there is little doubt that should the current in this way be found to vary in strength over long periods by 20 per cent or more, the observations would impress even the most sceptical.

At the outset, therefore, the *Atlantis* has undertaken to occupy a section extending from Montauk Point on Long Island towards Bermuda at approximately monthly intervals. If this were to be continued for five years, practically the entire time of the vessel would be consumed and the mathematical computations would also be most laborious. However, in theory it is only necessary to observe the density of the water at two points on each side of the current, and this greatly simplifies the calculation of the volume of flow. As soon as the validity of this new shorter method can be established, the *Atlantis* routine observational programme will be greatly shortened.

The circulation theorem of Bjerknes is based on the principle that when a current in the northern hemisphere increases in strength, the sea surface must fall on its left hand side and rise on the right hand side. The relative changes in height of the sea surface on the two sides of the current can either be calculated from the subsurface distribution of temperature and salinity or can probably be observed by means of tide gauges. This method has not yet been given a thorough trial, but a comparison of the tidal records from

Bermuda and from the American coast has been made, and for years when subsurface oceanographic observations are available good agreement has been found. Thus it may well be that before long the *Atlantis* routine observations on the Montauk Point - Bermuda section can be very much curtailed or even entirely abandoned and the fluctuations in the strength of the current followed entirely through the tide-gauge records. The theory tells us that the surface of the Sargasso Sea is about 100 cm. higher than that of the waters north-west of the current. This difference in level will vary directly with the strength of the current. Thus an increase of 20 per cent should cause a rise of about 10 cm. at Bermuda and a corresponding fall on the opposite side, a change readily observed from the records of a properly located recording tide gauge.

This method should prove especially useful in the Straits of Florida, through which about a third of the ultimate volume of the Gulf Stream passes. Consequently the *Atlantis* has recently set out to install a tide gauge in the Bahamas, just across from Miami where the U.S. Coast and Geodetic Survey maintains a similar instrument. It is hoped that when these records are compared with the results obtained farther north, it will be possible to say whether or not the Gulf Stream as a whole increases and decreases in strength from year to year.

In the case of wind currents and the calculation of the exact coefficient of friction between the atmosphere and the sea surface, the observational difficulties are considerably greater. Several methods are in theory available. For example, the stress exerted on the water by the wind can be observed through the disturbance produced in the turbulent layer of either the sea or the atmosphere. It is a problem in which both meteorologists and oceanographers are equally concerned and to which the methods of both sciences can be applied. Unfortunately, in the past it has been found to be extremely difficult to secure sufficiently precise observations. The difficulty is partly instrumental, but it also results from the disturbance produced both in the water and in the air by a large research ship. In addition, wind currents can of course best be observed in regions where there are no permanent deep currents. It is hoped that the small vessel which is being sent out to Bermuda by the Royal Society will prove handier for this work than other ships that have already been tried out. Likewise, it is hoped that a region can be found not too far from Bermuda where the permanent currents are negligible.

It was first assumed that the stress exerted by the wind on the surface of the sea was probably proportional to the strength of the wind. But recently Rossby has presented evidence which indicates that there is a critical wind velocity below which the wind can get little grip on the water. He believes that this critical velocity is probably reached when the wind has a strength of about 15 miles per hour. If this can be demonstrated by satisfactory observations, then the surface movements produced by the winds can be calculated from the ordinary daily ocean weather maps and all winds less than the critical velocity can be neglected.

Moreover, there has recently been collected an increasing amount of evidence that the strength of the wind currents depends also on the stability of the surface layer. When the stability is great, apparently only a shallow layer is affected by the wind and the principle of Ekman's spiral perhaps breaks down. Thus if these matters can be more fully investigated, the wind currents for the practical purposes of this new programme can perhaps be neglected during seasons when the stability of the surface layer in mid-latitudes is very great due to the absorption of solar energy. Although the full magnitude of the problem can now be but dimly seen from the available observations, it is hoped that the calculation of surface movements from weather charts may not be insurmountable.

The possibility that there exists a critical velocity below which the coefficient of friction is extremely small leads us back to the variations in the strength of the Gulf Stream. As already mentioned, in all probability it is the energy absorbed from the winds across the latitudes of the trades which supplies the initial driving force for the current. If the trade winds vary slightly in strength over long periods and if the critical velocity falls within this range, then it is evident how the ocean can absorb much greater amounts of energy in certain years than in others. On the other hand, if the coefficient of friction is proportional to the wind velocity throughout the range met with in the trades, it seems unlikely that they can be the cause of important variations in the currents farther north.

In conclusion, we must frankly admit that the general outline of the Bermuda project given here will probably seem over-ambitious. However, if we had been able to go into more detail, it could have been shown that many of the special phases of the main problem are much less complicated and that the five years work that is planned will by no means fail if the main objectives prove to be hopelessly complex. When the twenty-odd investigations already started or planned are examined, it is evident that the chief strength of the whole programme lies in its attempt to encourage

promising lines of investigation in physical oceanography. If several of these succeed, the entire effort will be justified. However, until physical oceanographers are able to show whether or not the surface layer of the ocean varies in temperature from year to year by a significant amount, they will get no peace from those who consider that science should have a practical objective. For this reason we hope we are justified in having attempted to explain how the work of the six or more co-operating investigators may eventually be fitted together. Let us hope that by such simple methods as observing the strength of the Gulf Stream in summer or by calculating the shift of the surface layer resulting from a prolonged spell of strong winds over the critical area west of Ireland, physical oceanographers will eventually be able to predict a mild winter or a good fishing season for northern Europe.

[1] MacBride, "The Bermuda Oceanographical Station", NATURE, **139**, 948 (1937).
[2] Off. Sci. Tech. Pêches Maritimes, *Revue des Travaux*, **8**, 360 (1934).
[3] Defant, "Dynamische Ozeanographie". (Berlin: Springer, 1929.) McEwen, "Physics of the Earth-V". (Washington: Nat. Research Council, 1932.)
[4] *Journal du Conseil*, **3**, 295 (1928).

Obituary Notices

Mr. Edward Meyrick, F.R.S.

LEPIDOPTERISTS throughout the world will learn with deep regret of the death on March 31, in his eighty-fourth year, of Edward Meyrick, in his time the greatest authority and the most prolific writer on the Microlepidoptera.

At least so early as 1875, Meyrick published notes and new records, but in December, 1877, a post at King's School, Paramatta, N.S.W., provided him with greater opportunities for indulging his interest in collecting and studying Lepidoptera, of which during his ten years sojourn in the Antipodes he amassed an extensive collection. In the *Entomologist's Monthly Magazine* of August, 1878, he wrote:

"I landed in December, the heat of summer, and have, therefore, only had half a year's collecting; and as I had been prostrated during the last two months by an attack of low fever, I had only three months of actual collecting; but I venture to assert that in the matter of *Micro-Lepidoptera* Australia stands pre-eminent among the nations [*sic*] of the earth."

Returning to Great Britain in January, 1887, Meyrick accepted the post, in the following September, of classics master at Marlborough College. This in no way hindered his entomological activities, and he was able to continue a series of contributions, commenced in 1879, to the literature of lepidopterology, unequalled in number and importance in the whole history of the subject.

In 1895 appeared his "Handbook of the British Lepidoptera", a remarkable achievement indicating his amazing energy and outstanding ability. Of this work J. W. Tutt (*Ent. Rec.*, 1895) wrote:

"Mr. Meyrick's is probably the book of the year. It is the strangest jumble of advanced views and retrograde movement that has ever been published.

"We have nothing but praise for the man who can step straight out of the old ruts, and produce a book which entirely upsets the treasured shibboleths of a school of entomologists, who were suckled on Newman and Stainton in their entomological babyhood, starved on Newman and Stainton in their manhood, and are still striving manfully to obtain nutriment from them in their old age. To such, if they see it, the book will be a revelation. But when one gets out of old ruts, one must know that the new road is sound and here our author is very doubtfully a trustworthy guide. The lines on which a new scheme of classification wants formulating must be compounded of the work done by specialists in various lines of work—Comstock, Dyar, Packard, Kellogg, Scudder, Chapman and Hampson are to hand. Instead of availing himself of all the material possible, our author chooses a path of his own, and neglects all the special work. Needless to say he often fails hopelessly. The unwieldy genera revert largely to the time when all butterflies were *Papilio*, all moths with pectinated antennæ, *Bombyx*, all 'Plumes', *Alucita*, and so on. In fact, the genera often comprise impossible combinations, and show the author to be utterly ignorant of the early stages of most of our British species. The book in detail is an utter failure; yet in its broad aspects, we repeat again, that we have the greatest respect for the industry and pluck of the man who produced it."

This violent and badly expressed criticism was not altogether unjustified, and it is surprising that Meyrick, in the second edition published in 1928, again failed to avail himself of a number of facts that had been demonstrated by other authors, although he made some additions. The work was, however, no worse than that of many other authors right up to the present day, not excluding Tutt himself, and one example may be given to demonstrate the terrible muddle which even now exists in the genera of moths.

Boisduval (1828) erected a genus *Heliophobus* for *Noctua reticulata* Vill. (1789) and some other species, *N. reticulata* later being cited as type by Duponchel (1829). No notice has ever been taken of this, and *Heliophobus reticulata* has been placed successively in the genera *Hadena*, *Neuria*, *Mamestra* and finally by Meyrick in Hübner's genus *Melanchra*, with the type of which it is certainly not congeneric. Likewise *Noctua albicolon* Hübn. has travelled through the following genera: *Mamestra*, *Barathra*, *Luperina*, *Polia*, *Trichoclea*, finally ending up in *Melanchra* in

Meyrick's "Handbook" (1928), although it is a true *Heliophobus*. I do not hesitate to assert that this is by no means an isolated case among the British moths.

In the first edition of the "Handbook" (1895) appeared the *dicta* which have been called "Meyrick's Law": (1) No new organ can be produced except as a modification of some previously existing structure. (2) A lost organ cannot be regained. (3) A rudimentary organ is rarely redeveloped. It strikes me as strange that Meyrick should have reprinted these statements without modification after thirty-two years. One would have preferred the following modifications: (2) A lost organ is not regained. (3) A vestigal organ is rarely redeveloped.

In 1912 Meyrick commenced a separate publication of his own which he called *Exotic Microlepidoptera* and described as "a spasmodic entomological magazine on one subject by a single contributor". In his original preface Meyrick wrote:

"The purpose of this volume is to ensure the speedy publication of material which is required for immediate use in other works proceeding at the same time, especially in my contributions to the *Genera Insectorum* and *Lepidopterorum Catalogus*; the delays incidental to publication through other channels would otherwise involve so much arrangement in advance as to seriously hamper the work."

Up to September, 1936, four volumes had been completed, running to some 2,500 pages in all, and during the next twelve months 160 pages of vol. 5 had appeared.

Latterly, Meyrick collaborated with Prince Aristide Caradja, the distinguished Roumanian lepidopterist, in a number of important papers on the Palæarctic Microlepidoptera (including Pyralidæ), with some valuable contributions to our knowledge of the Chinese fauna.

For many years Meyrick had identified Microlepidoptera and Pyralidæ for the Imperial Institute of Entomology. He was a very quick worker, a delightful correspondent and he rarely kept a colleague waiting long for identifications, always describing at once any new species.

I was pleased to note the impression made upon Meyrick, who was a man of very conservative views, by Wegener's theory of continental drift, even before the more recently collected evidence in support of it had been brought forward.

Meyrick was elected a fellow of the Royal Society in 1904. He had been a fellow of the Royal Entomological Society of London since 1880.

It is gratifying to learn that Mr. Meyrick's extensive collection, the value and importance of which it is impossible to estimate, is bequeathed to the British Museum (Natural History).

W. H. T. TAMS.

An anthropological correspondent writes:

For many years Mr. Meyrick was responsible for the records of anthropometric measurement of the Marlborough boys, on which he prepared the reports appearing in the publications of the Marlborough College Field Club. When the Inter-Departmental Committee on Physical Deterioration, which reported in 1904, was sitting, the lack of exact evidence relating to the trend of physical development in the child and adolescent population of Great Britain was a grave drawback; but the Marlborough records, being almost the only material available for comparative purposes extending over any considerable period of time, afforded information of the greatest value for the inquiries of the Committee. It was mainly on this material that the Committee based its finding that the public school population, at least, showed no evidence of the alleged physical deterioration in the population at large, into which the Committee was appointed to inquire. The absence of exact data respecting the physical development of the school population of England and Wales was one of the decisive factors in bringing about the passing of the Act of 1907 for the medical inspection of school children; though much to the disappointment of many who were among its strongest supporters, it was not considered practicable to introduce into the elementary school a scheme of anthropometric measurement of a more extended character.

Dr. G. B. Grinnell

THE death is reported of Dr. George Bird Grinnell, distinguished as geologist, naturalist and ethnologist, which took place in New York on April 11 at the age of eighty-nine years.

Dr. Grinnell was born on September 20, 1849, and educated at Yale University, where he graduated in 1870, proceeding to the degree of Ph.D. in 1880, and being awarded the D.Litt. in 1921. In 1870 he began his study of the Plains Indians, one of the activities for which he became most widely known. He was long recognized as the foremost authority on the history and customs of the Blackfeet, Pawnee and other Plains Indians, so that his appointment as Special Commissioner for the sale of lands to the Blackfeet and Fort Belknap Indians in 1895 was natural, and indeed inevitable. From 1874, when he joined the staff of the Peabody Museum as assistant osteologist, until his retirement in 1911, he was attached to this Museum or to the staff of Yale University. He was extremely active in collecting fossils and other specimens for the Museum, and took part in several expeditions, among them that to the Black Hills in 1874, the Yellowstone Park Reconnaissance expedition in 1875, expeditions to the Plains and the Rocky Mountains on behalf of his Museum, and the Harriman expedition to Alaska in 1899. Grinnell was the first in America to take action against the wholesale destruction of wild fowl and game, and his love for wild life in all its forms led to the foundation of the Audubon Society. For some years he was chairman of the Council on National Parks, Forests and Wild Life, and in 1925 succeeded President Hoover as president of the National Parks Association. In the same year he was awarded the Roosevelt Distinguished Service Medal for his lifetime's devotion to outdoor life.

News and Views

The "Jewish" Spirit in Science

IN July of last year, several correspondents sent us copies of an article entitled "'Weisse Juden' in der Wissenschaft", from the German periodical *Das Schwarze Korps* of July 15. The main theme of the article was that it was not sufficient to exclude all Jews from sharing in the political, cultural and economic life of the nation, but to exterminate the Jewish spirit, which is stated to be most clearly recognizable in the field of physics, and its most significant representative to be Prof. Einstein. "There is one sphere in particular," the article says, "where we meet the spirit of the 'White Jews' in its most intensive form and where what is common between the outlook of the 'White Jews' and Jewish teaching and tradition, can be directly proved, namely, in *Science*. To purge science from this Jewish spirit is our most urgent task. For science represents the key position from which intellectual Judaism can always regain a significant influence on all spheres of national life. Thus it is characteristic that in a time which brings fresh tasks to German medicine and which awaits decisive achievements in the fields of heredity, race-hygiene and public health, our medical journals should, in the space of six months, publish from a total of 2,138 articles, 1,085 from foreign authors, including 116 from Russians of the U.S.S.R. These articles of foreign origin scarcely concern themselves with those problems which seem so urgent to us. Under cover of the term 'exchange of experience' there lurks that doctrine of the internationality of science which the Jewish spirit has always propagated, because it provides the basis for unlimited self-glorification."

Prof. Stark's Views

SEVERAL men of science of international reputation were named in the article as followers of Judaism in German intellectual life, and it was remarked that "They must be got rid of as much as the Jews themselves". *Das Schwarze Korps* invited Prof. J. Stark to express his opinion upon this suggested purge on account of "the importance of the problem for the future of German scientific work". After reading Prof. Stark's reply, we asked him if it represented his considered views upon the relative values of experimental and theoretical studies; and if so, whether he would care to make them known to other men of science through the columns of NATURE. He willingly consented to contribute the article, of which a translation appears elsewhere in this issue. At the moment we make no comments upon the views expressed by Prof. Stark; and we gladly give him the opportunity of making them known to the scientific world. We should, however, be surprised if the limitations which these new principles impose on the pursuit of scientific truth are generally accepted as the highest or the best means of promoting the advancement of natural knowledge.

James Watt International Medal

To commemorate the bicentenary of the birth of James Watt on January 19, 1736, the Institution of Mechanical Engineers of Great Britain decided to award every two years a Gold Medal to an engineer of any nationality who is deemed worthy of the highest award the Institution can bestow and that a mechanical engineer can receive. In the making of the award the Institution has secured the co-operation of engineering institutions and societies in all parts of the world. To be worthy to receive a medal struck in commemoration of one who was at one and the same time a scientific investigator, an inventor and a producer, the recipient himself should be an engineer who has achieved international recognition both by his work as a mechanical engineer and by the ability with which he has applied science to the progress of mechanical engineering. The Institution recognizes, however, that only rarely will it be possible to find men in whom these qualities are so equally balanced as in James Watt. It will, therefore, consider men who have attained world-wide eminence in mechanical engineering in any direction—science or research, invention or production. After considering the recommendations of mechanical engineering societies in leading industrial countries throughout the world, the Council of the Institution of Mechanical Engineers has unanimously decided to make the second award of the James Watt International Medal to Mr. Henry Ford of Detroit, U.S.A., nominated by the American Society of Mechanical Engineers. The first award was made in 1936 to Sir John Aspinall, who unhappily died before the actual presentation was made.

Henry Spencer Palmer (1838-1893)

ON April 30 occurs the centenary of the birth of Major-General Henry Spencer Palmer, a distinguished British military engineer who did important work in various parts of the world. The son of a colonel, he was born at Bangalore, Madras, and after passing through the Royal Military Academy, Woolwich, entered the Royal Engineers in 1856. From 1858 until 1863 he was engaged on the survey of British Columbia. On his return he joined the Ordnance Survey and in 1867 took part in the parliamentary boundaries commission appointed under Disraeli's Act of that year. His next work was the survey of the Sinai Peninsula, and in 1873, through Airy, he was appointed chief astronomer of the expedition sent

to New Zealand to observe the transit of Venus of 1874. While at the Antipodes he assisted the French to determine the longitude of the Campbell Islands. He returned to England in 1875, and three years later was sent to Hong Kong as chief engineer of the Admiralty works. While there he designed a physical observatory for astronomical, magnetical, meteorological and tidal observations, and he made exact determinations of the position of the Hong Kong Observatory at Mount Elgin, Kowloon. In 1882, on his way home, he prepared a scheme for waterworks for Yokohama. This had been done at the request of the Japanese Government, and in 1885 he returned to the East to superintend the work. He also designed works for Osaka and Hakodate. He retired from the British Army in 1887 with the rank of major-general and died at Tokyo on March 10, 1893, at the comparatively early age of fifty-four years.

Research on Influenza

THE Medical Research Council has published a long report of the investigations made by Dr. C. H. Andrewes and his colleagues into the influenza epidemic of 1936–37 (Medical Research Council, Special Report Series, No. 228. London: H.M. Stationery Office, 1938. 2*s*. 6*d*. net). They have amply confirmed their previous discovery that there is an acute disease which may be properly called 'influenza', due to a virus which is specially infective for ferrets, and that many outbreaks of a somewhat similar kind are not associated with the virus; these they call "febrile catarrhs". Much attention was given to the possibility of diagnosing the real influenza by clinical means, and with a certain amount of success, though it is clear that accurate differentiation without demonstration of the virus is still rather uncertain. They have also confirmed the disconcerting American finding that all strains of the virus are not antigenically the same. Their plans for large-scale trials of preventive inoculation were anticipated by the epidemic, which came earlier than was expected and made a muddle of the experiments; so far as they went, however, they did not show that inoculation was of any preventive value. Nor did the few cases which were treated with an anti-serum derive much benefit. In these respects, therefore, the results are disappointing, though a good deal has been done towards obtaining greater success in the outbreak which may be expected next winter.

The Earthquake in Anatolia

ON April 19, a destructive earthquake occurred in central Anatolia. Its epicentre lay near Kirshehir, about 90 miles south-east of Angora, and in this district ten villages were completely destroyed and at least 200 persons were killed. In Yozgad, about 60 miles north-east of Kirshehir, much damage was also caused, but the loss of life was small. The disturbed area extended from the Black Sea nearly to the Mediterranean. The first vibrations reached London at 12.11 p.m., and the earthquake must therefore have occurred shortly before 2.30 p.m., local time, when most of the inhabitants were at work in the fields. Since the beginning of the eighteenth century, not less than thirty-one great destructive earthquakes (of intensity 3, Milne scale) have occurred in Turkey in Asia, with one exception either in the west of the country about Smyrna and Broussa or in the east about Erzeroum and Diarbekr. The central portion of the country has been comparatively undisturbed. From Miss Bellamy's "Catalogue of Earthquake Epicentres" we find that during the years 1913–30 there were six earthquakes in three centres near Kirshehir and Yozgad, though none was strong enough to be recorded more than 80° from the origin. In 1902, however, there was a destructive earthquake at Kastamonu, about 150 miles north of Kirshehir, of about the same intensity (degree 3) as the recent earthquake.

The Magnetic Storm of April 16

IN the note on the great magnetic disturbance of April 16 as recorded at Abinger Observatory, printed in NATURE of April 23, p. 721, it was only possible to give tentative estimates of the range in declination and horizontal intensity, for reasons then stated. Critical examination of the traces has since been made which confirms the estimate for declination but considerably reduces the figure given for horizontal intensity. The definitive ranges in the three elements are now stated, with the times of maximum and minimum, as below:

	Range	Maximum at	Minimum at
Declination (west)	5° 7′	6h.15m. U.T.	7h.50m.
Horizontal intensity	1380*γ*	7 54	7 21
Vertical intensity	494*γ*	7 52	7 36

York Museum of "Bygones"

THE Castle Museum, York, of which the nucleus is the collection of Yorkshire "Bygones" formed by Dr. J. L. Kirk, of Pickering, was formally declared open by Lord Middleton, lord lieutenant of the East Riding, on April 23. The Museum is housed in the eighteenth century buildings, formerly the female prison, of York Castle, which, with the exception of the medieval Clifford's Tower, vested in H.M. Commissioners of Works under the Ancient Monuments Acts, is now in the possession and under the control of the Corporation of the City of York. The Corporation will be responsible for the maintenance of the Museum, and the sum of £8,000, in addition to two grants of £500 each from the Carnegie Trustees and the Rowntree Trustees, has been expended on the installation. The exhibits, including a Tudor half-timbered house and fifteen shop-fronts in two and three storied houses flanking a cobbled street, illustrate the life, domestic, commercial and industrial, of Yorkshire over a period of two centuries ending with mid-Victorian times. Among the more striking and characteristic features are old hearths and their furniture and old agricultural implements and horse-brasses. By a judicious arrangement with the former owner, the Corporation has retained the right to enlarge the collection with the view of making the exhibits illustrate as fully as possible the old-time life of the folk of Yorkshire. An annexe, for example, is to be added shortly, which will house specimens of old and obsolete vehicles. As was pointed out at the opening ceremony by Dr. Mortimer Wheeler,

president of the Museums Association, the Castle Museum is a valuable addition to the all too scanty collections, which illustrate the past social life of England.

Science and the Home

THE great variety of material that the glass industry is now able to place at the disposal of the architect and the builder is well demonstrated by the 'Glass Hall' erected in the *Daily Mail* Ideal Home Exhibition at Olympia, which closes on April 30. The exhibits showed that in the hands of artist-craftsmen glass can be made a most effective medium of decoration. As regards the Glass House itself, the light-diffusing outer walls were made of fluted glass bricks permitting no observation from the outside. A partial vacuum inside renders them useful for the insulation as regards heat and sound. Each of the rooms of this house exhibits phases, useful and decorative, of the possibilities in glass, and the Crystal Kitchen has glass walls on two sides with the great merits of giving plenty of light and of being very easily kept clean. The Glass Train brought into Addison Road Station for the Exhibition, is, in a way, even more striking, as throughout it the walls, floors and ceilings are of glass. It is an exhibition in itself and includes examples of the 'Insulight' glass bricks mentioned above and of the Armour-plate glass, specially heat-treated so as to possess great fire-resisting properties with high mechanical strength. It can be bent through 30° without breaking and will withstand a range of temperature from — 70° C. to + 300° C. The numerous fittings and other features represent nearly six hundred different varieties of glass. In another branch of industry the domestic possibilities of 'Staybrite' in pans, sinks, door furniture, toilet fittings and table-ware are demonstrated. The strength and wearing properties of this and similar materials must inevitably prove their superiority in the home. Then for the purpose of keeping food fresh and cool, one of the oldest principles for the production of long-sustained low temperature is employed in the 'Kepkold' series of coolers. By keeping the surrounding absorbent tiles supplied with water the cooling effects of evaporation are obtained without recourse to the more expensive refrigerators the utility of which depends on a supply of electricity or gas.

Optical Projection of Surgical Operations

AN optical apparatus of some interest to surgeons, devised by Profs. H. Costantini and L. Verain, of the University of Algiers, has recently been produced by the firm of Barbier Bénard and Turenne, 82 Rue Curial, Paris. It is termed a 'Scialyscope' and is a development of the shadowless light now installed in many operating theatres. It consists essentially of a conical reflector nearly 2½ metres in diameter, and of roughly parabolic form, by means of which the rays from a very powerful light-source are concentrated on the field of operation. Beneath the lamp itself is placed an optical system containing a large right-angled prism by which an image of the field of operation is formed on a translucent screen in an adjoining room. The magnification on the screen is 3½ diameters, and the illumination is so powerful that a spectator at a distance of seven metres can obtain a brilliant view of every detail in the field of operation. There has always been very great difficulty in demonstrating operative details to a group of students; their mere presence in an operating theatre is undesirable, and it is obviously impossible for most of them to obtain any but a fleeting glimpse of what is happening. With this apparatus forty or fifty students in an adjoining room can easily follow every detail, and it will be noted that their view is obtained from a point immediately above the field of operation. By means of a microphone and a loud speaker, the surgeon can describe to them at the same time all that is being done. The method would appear to have considerable possibilities and it certainly overcomes the difficulties involved in demonstrating operative details to a number of individuals.

Report of the University of Birmingham

IN his seventeenth and last report to the Council, presented at the annual meeting of the Court of Governors of the University, the Vice-Chancellor (Sir Charles Grant Robertson) gives a summary of the progress of the University during his tenure of office. In 1920 "the high hopes, the vaulting ambitions and the dreams of a golden dawn that inspired a Great Britain freed by the Armistice from the terrors and horrors of the War slowly faded away or were frozen out, and in their place came spiritual and moral anarchy and the cynicism derisive of the past, and baffled by the present, that fears nothing but the future". Since then the University has gone rapidly forward. The income and expenditure in 1921 were £143,631 and £144,535 respectively, while for 1937 they were £232,690 and £230,805, not taking into account the sums for fellowships, scholarships and other trust funds which pass through the accounts of the University. Assets have increased to £2,199,306, and the University is free from debt, the contributions to the endowment since 1920 being not less than £930,000. The grants from local authorities have increased from £11,887 to £33,570. Expenditure in stipends has increased from £34,131 to nearly £100,000. There are now 34 full-time professors and 10 part-time, while the non-professorial staff now numbers 297. The Library grant has been quintupled and the number of readers and of books taken out has increased eightfold. "The function of a university library is not merely to satisfy existing needs, but to create new appetites as yet unknown and always unpredictable; you never can tell what may result from the contact of a young mind with an adequately equipped library. In a university more minds than we are aware of are always at flash-point. It is the spark that is so often wanting."

SIR CHARLES notes with satisfaction the success which has attended the large measure of self-government which has been given to the undergraduates—"the student body has justified the confidence that the unification of responsibility with power demands". He wishes, however, that a really serious share in

these activities were not left to an able but overburdened minority, and to a still smaller but very vocal opposition who find in the Vice-Chancellor and 'the authorities' the source of all their troubles. "But that is almost inherent in all 'day universities' in huge cities where two hours or more have to be spent daily in coming and going. It may require another generation to pass before the truth that a university education is a life together and not merely a learning together is grasped by every fresher at entry." The number of students which showed a steady increase until 1933–34 has since shown a progressive though small decline. This decline is viewed with some anxiety and is regarded as probably due to the fall in the birth-rate, the forecast being made that by 1955 the number of students may have fallen to not more than 1,200 or 1,300, or perhaps less. It is noted that about 45–50 per cent of the students hold scholarships or grants from public funds which enable them to take a university course, and that about 48 per cent started their education in an elementary school.

Obstacles to Teaching

In her presidential address on April 16 to the National Union of Teachers, Mrs. E. V. Parker, a teacher in a London County Council school, dwelt on those unfavourable conditions which hamper the work of teachers eager to contribute to the salvaging of civilization. The generous ideals of the Hadow Report, foreshadowing the elimination of social class distinctions in a unified system of public education and "freedom for every child to attain its full stature", have not been realized; nor can they be without provision by the community of proper material environment in school and home and drastic reduction of the size of classes. The freedom of the teacher is threatened with partisan interference which seeks "to sap and undermine by labelling many of our positive educational activities as propaganda". In the junior school the incubus of the external examination from which elementary schools were rescued in 1895 has reimposed itself as an instrument for selection for free secondary school places, which should be the birthright of every British child. In the new senior schools a large measure of freedom is enjoyed, but they need levelling up to the standard of the older secondary schools in point of leaving age, staffing and amenities. Meanwhile, it is essential that the last months before the child leaves school should be devoted to an earnest effort to gather up the loose threads of knowledge, to give meaning to all the work already done, making plain its applicability to the problems of life and providing the stimulus that will result in a continuance of interest and effort for self-education.

Japanese Nationalism and Intellectual Freedom

Japan won her high place among world powers in little more than a generation by a will to accept and assimilate ideas from outside her own culture, which was a cause of wonder and admiration among all civilized peoples. It is, therefore, all the more remarkable that this liberal attitude should now have been abandoned in favour of a spirit which interprets the springs of nationalism in the narrowest sense. A commission, it is reported by the Tokyo correspondent of *The Times* in the issue of April 21, is engaged in investigating the books in use in the universities of Japan with the view of determining whether they are fully in accord with the national spirit. Among books which it has been decided to ban are Mill "On Liberty", Bertrand Russell's "Roads to Freedom", George Gissing's "Private Papers of Henry Ryecroft", "Tess of the D'Urvervilles" by Thomas Hardy and "Ulysses" by James Joyce. The choice might seem peculiar, and, in fact, to English-speaking peoples almost capricious, even when it is added that the principles of selection exclude all books which encourage liberalism, offend morals, describe excessive cruelty, or whose authors have attacked Japan. With the exception of the ground last-named, which may or may not be regarded as excusable, such a policy seems not only over solicitous for the intellectual weakling, but even admirably calculated to produce the stunted judgment which in the long run will make for national weakness rather than strength.

The London Television Service

The paper on the London Television Service read to the Institution of Electrical Engineers on April 21 by T. C. Macnamara and D. C. Birkinshaw describes the television station recently built by the British Broadcasting Corporation in a part of the Alexandra Palace, London, N. The reports of the reception of the transmissions have in general been encouraging. The range of the station, originally estimated to be about 25 miles, has proved to be considerably farther in most cases; good reception can be obtained up to about 35 miles. Reports of visual receptions have been received from Brighton, Southend, Cambridge and Bedford, the distances of which from the station are 40–60 miles. In these cases reception took place under exceptionally favourable conditions. It has been found that in the ultra-short waves used for television, the interference due to electro-medical apparatus used for high-frequency diathermy is sometimes serious. For example, a North London hospital situated about half a mile from the Alexandra Palace has a spark diathermy machine which when used completely 'jams' the reception of the five-metre radio link transmitter at the Palace. The whole of the walls and ceiling of the room were covered with aluminium foil 5 mm. in thickness, applied with a paper backing after the fashion of ordinary wall paper. At one end of the room, which was open, a partition covered with ½ in. mesh chicken wire was erected and good electrical connexion made between the aluminium foil on the ceiling and walls and the chicken-wire. A similar screen was placed over the window and another was laid on the floor underneath the usual rubber floor material. The treatment effected complete suppression of the interference. If the screened door in the partition was opened by only a few inches, the interference was almost as bad as with the unscreened room. This proves the necessity of taking thorough measures.

A Bird New to Great Britain

AN interesting addition to the British bird list is described by H. F. Witherby in the March issue of *British Birds*, namely, the first identified specimen of the western little bustard (*Otis tetrax tetrax*). This specimen was one of two "strange birds" shot during a partridge drive at the Wadworth estate of Yorkshire, just south of Doncaster, so far back as December 9, 1922. The shooting tenant presented the specimen to Capt. E. W. S. Foljambe, who had it preserved at Osberton, Nottingham, whence he recently sent it to London for expert study. The whereabouts of the second bird shot on that date have not been traced. The western race of the little bustard inhabits Spain, Portugal, France and north-west Africa, and differs from the eastern race in the possession of more sandy-buff colour on the upper parts and wing-coverts, in having the black markings less pronounced, and the vermiculations finer. The eastern little bustard (*Otis tetrax orientalis*) had previously been recorded in Great Britain, and the specimen was at first thought to belong to that race. One was shot at Addlethorpe, Lincolnshire, in November 1933, another in Kincardineshire in 1912, one near Peterhead, Aberdeenshire, in January 1935 and one in Hampshire during a partridge drive in December 1935.

Journal of the Glasgow Mathematical Association

WE have only just received the first two numbers of this journal, although the first appeared so long ago as December 1936, and the second a year later. The Glasgow Mathematical Association is the successor to the "Euclidean Society" formed in Glasgow in 1927. Its objects form a curious contrast with those of the well-known Mathematical Association, which is the successor to "The Association for the Improvement of Geometrical Teaching". The objects of the latter might be described as revolutionary, in the first place to break away from the shackles of Euclid, and then to break away also from the traditional methods of teaching algebra, trigonometry and other branches of elementary mathematics. The Glasgow Association, on the other hand, is counter-revolutionary. Its original object was to adhere to Euclid's methods whenever the substitutes were considered unsatisfactory. An article by J. McWhan pleads also for a return to the "uninspiring but fundamental topics" in algebra and trigonometry, and claims that "the drill itself, and the concentration and self-discipline implied in it, are surely of the highest educational value", although "not in itself stimulating or pleasurable either to pupil or teacher". These views are supported by evidence as to the bad effects of modern methods of teaching.

THE *Journal* may be warmly recommended even to those teachers who do not consider that what is pleasant is probably evil. There are interesting historical articles on Stirling and Monge, and a most valuable exposition of the "Intuitionist" point of view concerning the nature of mathematics. This, if accepted, would necessitate a drastic pruning and remodelling of the whole of abstract function theory, such as the Heine-Borel theorem, and would reject the theory of non-enumerable classes and Lebesgue measure as merely "verbal mirages". There is also an article on compass constructions, and notes on the teaching of geometrical progressions, medial section, the construction of triangles, the sums of powers of the natural numbers, and the binomial theorem.

Plague Research in India

IN the report of the Haffkine Institute, Bombay, recently issued, the Director, Lieut.-Colonel Sokhey, summarizes the work of the Institute during 1936. It is the centre for the manufacture of plague vaccine for the whole of India, and more than 800,000 doses of vaccine were issued during the year. Much work has been done on the standardization of the dose of virulent plague bacilli for measuring the protective power of plague vaccines, and upon the preparation of a potent anti-plague serum for treatment. Investigations on the epidemiology of plague have shown that the house rat in some localities is resistant to plague, but that in them the small field rat is highly susceptible, and is probably responsible there for the spread of the disease.

The Night-Sky in May

THE moon is full on May 14^d at $8{\cdot}6^h$ and new on May 29^d at $14{\cdot}0^h$ U.T. At full moon, a total eclipse of the moon occurs, but this is invisible from Europe. At new moon on May 29, a total eclipse of the sun takes place, but this phenomenon is likewise invisible from Europe, the path of totality lying in the southern part of the South Atlantic Ocean. The sun will be seen partially eclipsed from South Africa and the southern part of South America. Amongst the occultations visible from Greenwich this month may be noted the following: on May 2 at $20^h\ 5{\cdot}1^m$ the disappearance of 106 Tauri (mag. 5·3); on May 3 at $20^h\ 41{\cdot}8^m$ the disappearance of 68 Orionis (mag. 5·7); on May 12 at $20^h\ 57{\cdot}2^m$ the disappearance of B.D.—15° 3817 (mag. 5·1) and on May 17 at $1^h\ 39{\cdot}0^m$ the reappearance of 58 Ophuichi (mag. 4·9). Of planetary phenomena to be looked for is the unusually close approach of Venus and Mars on the evening of May 7, the actual conjunction taking place on May $8^d\ 0^h$, that is, about 2½ hours after the planets have set below the horizon at Greenwich. Binoculars should be used to see this interesting phenomenon, and the difference in colour of the two planets will be observed. On May $1^d\ 19^h$ and May $31^d\ 16^h$, Venus is in conjunction with the moon; on May $2^d\ 1^h$ and May $30^d\ 18^h$, Mars is in conjunction. Jupiter, a morning star, is in conjunction with the moon on May $22^d\ 17^h$. In the middle of the month at 21^h a very interesting region of the sky is on the meridian. This region contains an assembly of nebulæ in Virgo and Coma Berenices and the loose cluster of bright stars that form the mythical tress of hair of Berenice. East of this cluster is the north galactic pole, in the direction of which the 100-inch telescope has explored the remote extra-galactic nebulæ to a distance of more than 500 million light years. Hubble states

that, on long exposure plates taken under good conditions with the 100-inch reflector, the recognizable nebulæ in the direction of the galactic poles average about 2,400 per square degree and are more numerous than the stars!

Announcements

THE Gold Medal of the Royal Society of Medicine, given triennially in recognition of services to the science and art of medicine, has been awarded to Prof. Wilfred Trotter, director of the surgical unit at University College. Prof. Trotter is the seventh recipient of this medal, his predecessors having been Sir Almroth Wright, Sir F. Gowland Hopkins, Prof. J. S. Haldane, Sir Henry Head, Sir Thomas Barlow and Sir Archibald Garrod.

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to Prof. S. J. Truscott, "in recognition of his services in the advancement of the science and practice of mining and metallurgy, with special reference to his services in technological education". The Consolidated Gold Fields of South Africa, Ltd. Gold Medal has been awarded to Prof. H. V. A. Briscoe, "in recognition of his researches on the sampling and properties of industrial dusts"; The Consolidated Gold Fields of South Africa, Ltd. Premium of forty guineas has been awarded conjointly to Dr. Janet W. Matthews, Mr. P. F. Holt, and Miss Phyllis M. Sanderson, "in recognition of their work, in association with Prof. H. V. A. Briscoe, on the sampling and properties of industrial dusts".

THE following have been elected members of the Royal Danish Academy of Sciences and Letters, Copenhagen: Prof. Einar Lundsgaard, Copenhagen; Prof. H. O. Eilert Ekwall, Lund; Prof. Didrik Arup, Seip; Prof. V. M. Goldschmidt, Oslo; Prof. Haaken H. Gran, Oslo; Prof. Theodor Frings, Leipzig; Prof. Albrecht Götze, New Haven; Prof. R. L. Enno Littmann, Tübingen; Prof. Richard Goldschmidt, Berkeley; Dr. Peyton Rous, New York; Prof. August Thienemann, Kiel.

PROF. ALEXANDER W. EVANS, Eaton professor of botany in Yale University, known for his work on the Hepaticæ (liverworts), celebrates the seventieth anniversary of his birthday on May 17. A dedicatory volume of *Annales Bryologici* is being prepared to mark this occasion. This "Festschrift" contains a biographical notice and portrait of Prof. Evans together with about twenty-five contributions from leading American and European bryologists and hepaticologists.

AT a meeting of the Royal College of Physicians of London held on April 11, Dr. Robert Hutchison, consulting physician to the London Hospital and to the Children's Hospital, Great Ormond Street, was elected president in succession to Viscount Dawson of Penn.

A GENERAL COMMITTEE, consisting of the Council of the Royal Society of Edinburgh and a number of leaders in science and education, has been formed to further the project of securing a portrait of Sir D'Arcy Wentworth Thompson, president of the Society, to be hung in the Society's Rooms. The portrait is being painted by Mr. David S. Ewart. Dr. James Watt is treasurer of the Fund, and will be glad to acknowledge any remittances sent to him at the Society's Rooms, 22 George Street, Edinburgh, 2, marked "R.S.E. President's Portrait Fund".

MR. H. F. BROADBENT left Port Darwin on April 17 and flew to Lympne arriving at 10.51 on April 22, the actual flying time for the journey being 5 days 5 hours 21 minutes. He thus beat the record previously held by Miss Jean Batten by 12 hours 54 minutes.

AT its last general meeting, the Vienna Biological Society elected Profs. Harvey Cushing of New Haven, U.S.A., Sir F. Gowland Hopkins of Cambridge and C. G. Santesson of Stockholm as honorary members, and Profs. A. v. Muralt of Berne, G. Bayer of Innsbruck, H. Guggisberg of Berne, Barkar of Tartu and Anrep of Cairo as corresponding members.

THE Jugoslav State has allotted a sum of four million dinars to the Jugoslav Society for the Social and Scientific Campaign against Cancer to enable a cancer institute to be founded at Belgrade.

ON the occasion of the eightieth birthday of King Gustav V of Sweden on June 16, a Swedish fund will be organized for the investigation and control of common diseases, especially poliomyelitis and rheumatic disorders.

THE Vienna Sectional Meeting of the World Power Conference will, notwithstanding recent political events, be held on August 25–September 2, 1938, and the programme remains unaltered. At the recent annual general meeting of the British National Committee, it was decided to proceed with preparations for British participation in the Vienna meeting. Sir Harold Hartley has again been elected chairman of the British National Committee of the World Power Conference, to serve for a further term of three years.

THE lecture entitled "Some Carbohydrate Problems" arranged to be given by Prof. W. N. Haworth before the Chemical Society on May 5 at 8 p.m., has been postponed. Instead, Prof. J. Masson Gulland will deliver a lecture on "Nucleic Acids".

THE writer of the article on the "Teaching of Technical Optics" in NATURE of April 9, p. 654, regrets that by inadvertence he omitted the firm of Messrs. Aldis Brothers from among the makers of photographic lenses. This firm has made photographic lenses since 1902; it has a Cambridge graduate as designer and is, of course, well known for the high quality of these lenses. The name of the firm was mentioned in the article among those of other firms which have devoted particular attention to the design of lens systems.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 793.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Social Relations of Science

ABSENCE abroad has prevented me from responding sooner and expressing, as invited, an opinion on the proposals in the article entitled "Social Relations of Science" printed in NATURE of April 23. Though to me they come too late and too tainted with officialdom and regimentation to appear to be much more than a wish to be in at the shouting, it would be churlish not to express gratitude that they are, at least, explicit and capable of being intelligently discussed.

The effect of scientific discovery on the whole framework and content of sociology, economics and politics has been with me a major preoccupation for nearly twenty years. In that time, I have had the satisfaction of seeing grow from very small beginnings what is no exaggeration to say is an entirely new outlook and philosophy of life. Everywhere in the teeth of every sort of ignorance, prejudice and vested interest, academic, political and financial, I have witnessed the realization spread over the world like wildfire, since the Great War, of what the scientific civilization might be, but for the procrustean bed of a private, upstart and frustrating monetary system.

Academic scientists, I should judge, have much more to learn of the potentialities of an unfrustrated and deprocrusticated scientific civilization than they are able to teach. They seem still pitiful dupes of Procrustes, at best trying to mitigate the sufferings of those mutilated, rather than to provide a decent bed, and only now really interested because their own precious freedom from interference is being threatened.

The proposal is for a new sort of Royal Society to be formed to discuss these matters, having a large membership and all the usual paraphernalia of council, committees, "suitable" referees, regular meetings, symposia and publications. Though it has to deal with subjects which, not to put a gloss on it, affect everybody's pocket more or less and that of Procrustes very closely indeed, its attitude is to be strictly objective and scientific. It is not to express corporate "opinions" (decisions or conclusions, surely, would be less 'in the dreary and barren dialectical tradition') but everyone is to be left free to make up his own mind as an individual. It is claimed that what has worked well in the old field of knowledge for its own sake will, there is every reason to believe, meet with "like success" in the new. Accepting, so to say, the prospectus at the promoters' own valuation, "like success" means nothing beyond the creation and diffusion of a well-informed body of opinion. What is proposed is just another debating society in addition to the hundreds of societies studying this very problem all over the world, but distinguished by being composed preponderatingly of people to whom both the technique and methods of science are familiar, qualities which are rather more in evidence in the individuals engaged in the pioneering of new knowledge than in their organizations.

Well, the existing societies already studying these problems in much this way without, it is true, the qualification of mass scientific intellect, have come to a sort of consensus of opinion that it is the monetary system which is at the bottom of the whole hell's brew. Is the proposed society to be allowed to make a purely scientific and objective investigation into the existing money system? The lack of specific reference to this in the agenda, and, indeed, the rather naïve idea underlying this new phase of the movement, that the massive intelligence of organized science should be shipped off on a quest into these uncharted seas, when as a matter of fact the whole thing already could be made clear to the uncorrupted mind of a child, makes me ask the question. If I may suggest the answer, it is that in a matter so nearly touching the very core of government, the new society like the old will be expected to be on the side of the Government of the day, whatever that may be, rather than on that of the veiled goddess.

Be that as it may, I am sure everyone who has already been independently examining the question with an open mind will want to know on which side of the fence the proposed society is expected to sit; whether, like the Royal Society in so far as, since the War, it has largely become an unofficial part of the Civil Service, it is to be concerned with the sort of knowledge most useful in preserving and strengthening the existing framework of society, or with changing that framework so as to make the world safe for a scientific civilization. I know that, theoretically, the two sides should be the same, but in practice they may be exact opposites.

When we come to what after all is the object, *the change of the system*, be it the monetary system or whatever else may be adjudged to be the prime cause of civilization running off the rails, what is the use of a debating society? Are we still supposed to subscribe to the idea that "in this country at least", once a sufficient and sufficiently well-informed body of opinion exists as to what is wrong, it will come all right? I suppose some people still think vaguely along these lines, but I am not among them, not in the present instance.

If we study actual examples of changes recently effected, associated with the names of Mussolini, Gandhi, Hitler, Lenin and his successors, much as they differ in method, they all seem to depend primarily on the creation or renewal of faith in the future destiny of their own particular race or civilization. So it would appear that, if the scientific civilization is to survive, scientific workers should strive to create a mass-belief in its superiority, as regards both material and spiritual satisfactions, alike over the hoary civilizations we are still imitating, and the meteoric substitutes since the War. All scientific

thinkers must themselves feel this superiority intensely, but it would be a good thing if their allegiance was less clannish, and, in their external relations, they were less like the herd in thinking these threatened catastrophes as either inevitable or beyond the power of science to prevent. For, indeed, the amount of science required is, in my view, much of the two-plus-two variety. What is more wanted is not a new organization but a Crusade of Scientific Civilizers, a C.S.C. not an S.R.S.

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Complex Formation in Lipoid Films

IT was shown recently[1] that when extremely dilute solutions of certain substances were injected into the substrate under monolayers of various types, the injected substance (for example, cetyl sulphate) penetrated the monolayer (for example, cholesterol), forming a mixed film containing equal numbers of the two molecular species. These experiments were carried out at constant area.

Two experimental methods have now been devised to study area changes in these mixed films formed by the penetrative process under various compressions. In one, a Langmuir trough is employed, the surface tension of the solution behind the barrier being separately determined. In the other, a thin strip of waxed paper attached to the sides of the trough by long vaselined silk threads serves as a barrier. The monolayer under examination is placed in front of the barrier, and behind it a lens and film of a suitable substance serves as a Langmuir piston to compress the monolayer. This piston film, for example, triolein (piston pressure 23 dynes/cm.), must consist of a substance which is not penetrated by the material injected into the substrate.

With a monolayer of cholesterol compressed by a triolein piston, the injection of a dilute solution of digitonin causes an immediate expansion of the monolayer to twice the area, and the previously liquid cholesterol film becomes solid. The triolein is unimpaired and continues to exert a compressive pressure of 23 dynes per cm. If instead of digitonin, cetyl sulphate in suitable concentration be injected and oleic acid is employed as piston (35 dynes/cm.) the area increase is only 50 per cent instead of 100 per cent. Here again, since the molecular areas of cholesterol, digitonin and cetyl sulphate are 40 A.^{2}, 40 A.^{2} and 20 A.^{2} respectively, a complex of 1 : 1 is formed. Replacing oleic acid by the less compressive triolein piston, it is found that on injection of the cetyl sulphate there is an immediate expansion of 50 per cent forming the 1 : 1 complex. This is followed at these lower pressures by a further slow expansion, indicating the formation of a less stable complex of the composition cholesterol, cetyl sulphate (1 : 2). Care has to be taken to avoid leaks, since the detergents in excess remove the liquid paraffins from the threads.

It is of interest to note that a solution of cholesterol in petrol ether spreads rapidly on water and on a solution of cetyl sulphate, but not on digitonin; hence surface peptization is only brought about by the formation of complexes which must be liquid and in order to spread must have stability pressures greater than the equilibrium surface pressure of the underlying solution. With the Langmuir trough it is possible to examine this complex formation over a wider range of areas and pressures. The following general types of complex emerge from this investigation.

(*a*) When both monolayer and penetrating molecules are ring structures, only 1 : 1 complexes are stable.

(*b*) i. When the penetrating molecules are chains penetrating into a monolayer of ring structure, complexes containing one, two, and possibly three chain molecules per molecule in the monolayer have been established.

(*b*) ii. In the inverse system to the above, two chain molecules in a monolayer can interlink with one ring structure molecule from the substrate.

(*b*) iii. Finally, if both monolayer and substrate molecules are linear, two, and possibly as many as three, molecules from the substrate can form from a complex with one in the monolayer, in agreement with a centred hexagonal packing.

(*b*) iv. Van der Waals forces play a large part in the stability of these complexes; thus if dodecyl sulphate instead of cetyl sulphate be used, only very weak 1 : 1 complexes can be established.

We may note that in chain-like molecules insertion of a double bond in the chain may reduce the penetrative power; thus cetyl sulphate penetrates readily a film of the *trans* elaidyl alcohol to form an 'interlocking' solid, 1 : 1 mixed film, but only penetrates with difficulty the *cis* oleyl alcohol, to form a liquid film readily decomposed by pressure. As is to be anticipated, the formation and stability pressures of a series of complexes is dependent not only on the surface pressure, but also on the bulk concentration of the penetrating agent. Again, the formation of complexes is in many cases extremely sensitive to quite minor changes in the *p*H of the underlying solution; thus bilirubin penetrates cholesterol with ease at *p*H 7·2 but has a negligible effect at *p*H 8·2. Biliverdin does not penetrate cholesterol at all. On the other hand, taurocholic acid forms no complexes with bilirubin as measured by these methods.

It is hoped shortly to give an account of the systems investigated, together with the data on the stability of complexes of cholesterol with various substances in respect to their hæmolytic activity and with natural pigments and bile salts as a possible factor in the formation of gall stones.

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April 2.

[1] *Proc. Roy. Soc.*, B., **122**, 29 (1937).

Isomeric Forms of Radio Rhodium

WHEN bombarded by neutrons, rhodium gives two radioactive periods, 44 sec. (Rh_1) and 4·2 min. (Rh_2), both being associated with the emission of negative electrons.

Amaldi, Fermi[1], and Segrè[2] have shown that the ratio of the two activities produced in rhodium by *slow* neutrons does not change if the neutrons are filtered with cadmium or rhodium. This indicates that the resonance levels for the capture of slow neutrons which lead to the formation of Rh_1 and Rh_2 have about the same energy and breadth. This supports the hypothesis that the formation of Rh_1 and Rh_2 corresponds with the capture of neutrons in a single level of a definite isotope, that is, that Rh_1 and Rh_2 are two isomeric forms of the same isotope. The experiments of Frisch, von Halban and Koch[3]

lead to the same conclusion. A possible explanation of nuclear isomerism has been proposed by Weizsäcker[4].

It is interesting to examine the significance of the ratio R of the saturation intensities of the two periods (all references will be to the 'true ratio', account being taken of the penetration of β-rays and neutrons; the details of the following experiments will be published elsewhere). When a neutron is captured, the compound excited nucleus may emit one or more photons before falling either to the state corresponding to Rh_1 or to that corresponding to Rh_2. The experimental ratio R will give the ratio of the probabilities of formation of Rh_1 and of Rh_2 from a capture level.

One may ask whether this ratio varies when the capture level changes, that is, when one varies the energy of the incident neutrons. There is evidently a close analogy between this question and the following: Does a change in neutron energy vary the spectral composition of the γ-radiation which is emitted by a nucleus in the capture of neutrons? An experiment on the capture radiation of slow neutrons in gold[5] has answered this question in the affirmative. Considering the experimental difficulty in studying γ-radiation in this case, it is easier to follow the same general investigation by means of new methods such as those described in the following. The rhodium (Dr. Jacquet kindly made an electrolytic deposit of 5 mgm./cm.[2]) on the interior of a nickel cylinder was irradiated for 20 minutes and its activity was followed in a Geiger-Müller counter with a thin aluminium wall (the counting began 20 seconds after the end of the irradiation).

From the curve of decay of the total activity ($Rh_1 + Rh_2$) one can deduce the value of the ratio R of the initial intensities of Rh_1 and Rh_2. This ratio was determined:

(*a*) With a source of radon plus beryllium (or radio-actinium plus beryllium) in the presence of paraffin. In this case it is known that the ratio R does not depend upon geometric conditions[1]. The result $R_a = 11 \pm 0{\cdot}7$ confirms the value found by Segrè[2].

(*b*) With a source of radon plus beryllium placed on the axis of the cylinder of rhodium, in the absence of paraffin and all hydrogenous media. It is known that for a radon plus beryllium source the number of neutrons of energy greater than 10^6 e.v. is probably less than 10 per cent of the total number of neutrons emitted[6]. Moreover, as the capture cross-section in general is greater the slower the neutrons, one can say that the rhodium cylinder is bombarded by heterogeneous neutrons with a mean energy less than 10^6 e.v. The irradiation was made at the interior of a 'castle' of lead, thus augmenting the activity through the presence of neutrons diffused by inelastic collisions in the lead. The mean energy of these neutrons is smaller than that of the slow group of neutrons from radon plus beryllium, as one can determine by measuring directly the absorption in cadmium[7]. The value $R_b = 6 \pm 0{\cdot}5$ was obtained.

It should be noticed that in (*a*) the experimental value R_a is relative to the neutron capture by a *single level*. On the other hand, in (*b*), R_b represents a *mean value* referring to a great number of levels. This is due to the fact that the neutrons which excite Rh_1 and Rh_2 in the conditions (*b*) have a very complex spectrum. Moreover, in the case (*b*) the breadth of the levels is probably greater in the mean than is their separation. It might be expected that in an energy interval which is small with respect to the total excitation energy of the nucleus, the *mean value* of R should not change appreciably. Consequently, the result of this experiment ($R_a \pm R_b$) seems to show that the mean value of R in a certain energy interval differs from the value relative to a single level of this interval.

This is in accord with the experiment on the γ-radiation of capture in gold and with the experiments on the selective production of isomeres in uranium[8], that is, neighbouring levels show a difference of behaviour (in the sense already explained).

As Placzek has remarked[9], it seems that the nuclear levels can be grouped into different classes which cannot intercombine in the spectroscopic sense of the word.

After these experiments were finished, there was published the results of measurements of R in rhodium for neutrons of different energies[10]. Here, however, it is difficult to draw conclusions on the radiative properties of the nucleus, because the value of R was determined in one case for slow neutrons and in the other for neutrons of very high energy (neutrons from D + D: 2·4 M e.v.).

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March 30.

[1] Amaldi and Fermi, *Phys. Rev.*, **50**, 899 (1936).
[2] Segrè, *Ricerca Scient.*, **7**, 389 (1936).
[3] Actes du congrès international du Palais de la Decouverte, Paris (1937).
[4] Weizsäcker, *Naturwiss.*, **24**, 813 (1936).
[5] Pontecorvo, *J. Phys. Radium*, **7**, 511 (1936) and ref. (3).
[6] See, for example, Bjerge, *Proc. Roy. Soc.*, A, **164**, 243 (1938).
[7] Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti, Segrè, *Proc. Roy. Soc.*, A, **149**, 522 (1935).
[8] Hahn, Meitner, Strassmann, *Z. Physik*, **106**, 249 (1937) and Curie, I, and Savitch, *J. Phys. Radium*, **8**, 385 (1937).
[9] Placzek, ref. (3).
[10] Reddemann, *Naturwiss.*, **8**, 125 (1938).

Formation of Mesomeric Systems

THE recent article[1] by Prof. Ingold on "Resonance and Mesomerism" prompts me to refer to an aspect of this subject which has presented itself in connexion with the study of aliphatic diazo-compounds[2].

The tendency to the formation of saturated systems (for example, of aromatic from dihydrobenzene or from quinonoid derivatives; and of conjugated from unconjugated dienes) is a commonplace of organic chemistry. The generalization, that mesomeric systems are likely readily to be formed from others closely related to them, not only embraces those just mentioned but is also much wider in scope and should prove to be correspondingly more valuable. Thus, adopting Ingold's notation, we at once comprehend the formation of azoxybenzene (I), or of diazoamino- (II) in preference to aminazo-compounds:

$$\mathrm{Ph.\,NO + Ph\,NO\,OH \rightarrow Ph.\,\overset{\downarrow}{N} - \overset{\downarrow}{N}.\,Ph \rightarrow Ph.N\overset{\downarrow}{\frown}N.\,Ph + H_2O.}$$

(I)

$$\mathrm{PhN_2Cl + R\,NH.\,Ph \rightarrow Ph\,N\frown N\frown NR.\,Ph.}$$

(II)

The transition from methyl diazohydroxide to diazomethane is exactly comparable with these:

$$CH_3.N=N.OH \rightarrow H_2C\overset{\frown}{-}N\overset{\frown}{=}N + H_2O.$$

Similarly, whilst ammonia and aliphatic amines merely form additive compounds with aldehydes, loss of water ensues when aromatic amines, hydroxylamine, etc., are employed, so that mesomeric systems

$$>C\overset{\frown}{-}N\overset{\frown}{-}Ph, \quad >C\overset{\frown}{-}N\overset{\frown}{-}OH, \text{ etc.}$$

may be generated.

Their mesomeric character must also conduce to the generation of such systems by synthesis, and this is exemplified by the facile oxidation of nitrosobenzene, hydrazobenzene, azobenzene, isocyanides and *iso*acetylenes respectively to nitrobenzene, azobenzene, azoxybenzene, isocyanates, and ketenes. The formation of unsaturated systems is a special and particularly important case of this kind. The easy generation of styrene from boiling α-phenylethyl bromide, of stilbene from dibenzyl, of phenylbutadienes from the corresponding cinnamyl methyl carbinols, and of ethyl styrene by reduction of phenylbutadiene, are examples of long standing in the literature. Contemporary instances are readily discerned in the various syntheses of polyenes evolved by R. Kuhn and his collaborators[3], not the least noteworthy and significant being the adaptation of Klinger's synthesis of stilbene by reduction of thiobenzaldehyde. Similarly, it may well be that resonance is a determining factor in the biosynthesis of carotinoid and similar substances.

It would also appear that among inorganic compounds the familiar tendency of compounds representing intermediate stages of oxidation to pass spontaneously into others of lower and higher degrees, respectively; for example

$$3ClO' \rightarrow 2Cl' + ClO'_3,$$

is attributable to the greater resonance in the latter, as is also Luther's well-known rule, that in the conditions under which the transition occurs the intermediate stage of oxidation corresponds to a greater oxidation potential than the higher one. Similar considerations may explain the tendency of non-resonant anions derived from a single atom, for example, sulphur, halogen, or oxygen, to form resonant complexes by combination with elementary sulphur, free halogen, and atmospheric oxygen respectively. From this point of view, it might be anticipated that the ionic rather than the homopolar condition would be the predisposing factor, and it is noteworthy that, among the alkali and alkaline earth metals, it is the oxides of the most electropositive which most readily form higher oxides.

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March 25.

[1] NATURE, 141, 314 (1938).
[2] Compare *Chemistry and Industry*, 59, 203 (1938).
[3] Compare the review in *Z. Angew. Chem.*, 50, 703 (1937).

Deuteron-induced Radioactivity in Oxygen

WHEN oxygen gas and several oxides (carbon dioxide, tungsten trioxide and water) were bombarded by 2 M.e.v. deuterons, which were obtained by the aid of our cyclotron, two periods for oxygen were definitely established.

A first period of one minute and a half is identified with that of ^{17}F, which has been already established by many authors[1,2].

A second period of 120 min. is shown by chemical separation to be also due to an isotope of fluorine and is close to the 112 min. period of ^{18}F found by Snell[3], when he bombarded neon with 5 M.e.v. deuterons, and also to the 107 min. period of the same isotope found by DuBridge, Barnes and Buck[4], when they bombarded oxygen with high-speed protons (1·4–3·8 M.e.v.). We thus identify the second isotope with ^{18}F.

The energy histogram of positrons emitted from this isotope was taken by the aid of a Wilson cloud chamber filled with hydrogen. The upper limit of the energy is found to be 0·7 ± 0·05 M.e.v. This is again close to 0·6 M.e.v.[3] and 0·5 M.e.v.[4], which were obtained from absorption experiments.

This isotope may possibly be produced according to the reaction:

$$^{17}O + {}^2H \rightarrow {}^{18}F + {}^1n$$
$$^{18}F \rightarrow {}^{18}O + \epsilon^+$$

The relative abundance of this isotope of oxygen is very small; hence to get an appreciable quantity of ^{18}F the cross-section of this reaction must be rather large. Further, when we consider the large abundance of the oxygen isotope ^{16}O, there remains a certain probability that it may be attributed to the following reaction, which has not yet been observed.

$$^{16}O + {}^2H \rightarrow {}^{18}F + h.$$

If this is the case, γ-rays of about 11 M.e.v. would be expected to be emitted during this reaction, according to mass defect consideration.

As for the third isotope of oxygen, ^{18}O, the reaction:

$$^{18}O + {}^2H \rightarrow {}^{18}F + 2{}^1n$$

must be abandoned according to the energy relation unless the kinetic energy of the deuteron exceeds 5 M.e.v.

The full account of the energy histogram and the Konopinski-Uhlenbeck plot of positrons emitted from ^{18}F will shortly be published, together with those of ^{13}N, in the *Scientific Papers* of this Institute. In conclusion, our thanks are due to Dr. Y. Nishina and other members of this Laboratory for their continuous interest and valuable assistance. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipment used for the cyclotron, and the Mitsui Ho-onkwai Foundation and Tokyo Electric Light Company for financial support.

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Feb. 28.

[1] Newson, *Phys. Rev.*, 48, 790 (1935). Wertenstein, NATURE, 133, 564 (1934). Kurie, Richardson and Paxton, *Phys. Rev.*, 49, 368 (1936). Pool, Cork and Thornton, *Phys. Rev.*, 52, 41 (1937).
[2] Snell, *Phys. Rev.*, 51, 142 (1937).
[3] DuBridge, Barnes and Buck, *Phys. Rev.*, 51, 995 (1937).

Sodium in the High Atmosphere

IN the spectrum of the sky at twilight, a yellow radiation was found very near the mean wave-length of the sodium D lines ($\lambda = 5893$ A.). This radiation is relatively strong, but its intensity decreases abruptly in one or two minutes (Fig. 1), as if it was first excited, or rather considerably enhanced, under the action of the sunlight. Observations made at the Tromsø Observatory, in the autumn of 1937, have shown that the excitation occurs in a layer at the altitude of about 60 km.

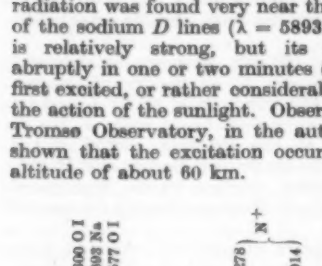

FIG. 1.

TWILIGHT SPECTRA (TROMSØ). (*a*) EXPOSURE, 15h. 47m.–15h. 52m. (*b*) EXPOSURE, 15h. 53m.–15h. 58m.

The same phenomenon was observed in December 1937 at Saint-Auban (Basses Alpes, France) and later in Lyons. In these latitudes, the shorter duration of twilight does not permit the determination with the same precision of the moment at which the yellow radiation practically fades. However, from a few spectrograms obtained in France, the altitude of the upper limit of the luminescent layer has been found again to be nearly equal to 60 km., in perfect agreement with the Tromsø measurements.

The yellow radiation was also studied by the interference method, using Fabry and Pérot interferometers (having glass plates 0·15 or 0·30 mm. apart) and also a quartz plate 1·5 mm. thick approximately. The results proved that this radiation

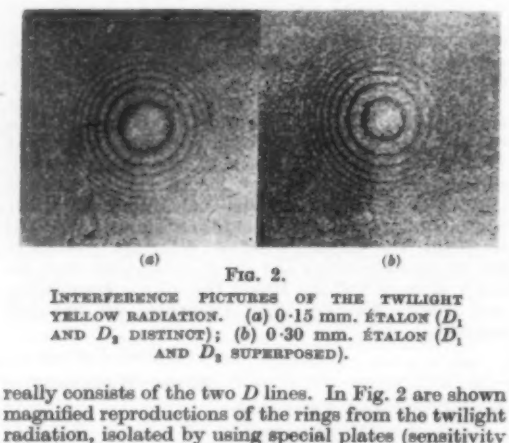

FIG. 2.

INTERFERENCE PICTURES OF THE TWILIGHT YELLOW RADIATION. (*a*) 0·15 mm. ÉTALON (D_1 AND D_2 DISTINCT); (*b*) 0·30 mm. ÉTALON (D_1 AND D_2 SUPERPOSED).

really consists of the two D lines. In Fig. 2 are shown magnified reproductions of the rings from the twilight radiation, isolated by using special plates (sensitivity rapidly decreasing from the yellow to the red) and a suitable filter limiting the spectrum at 5750 A. On the left half of each picture, the rings produced by the yellow light of sodium (alcohol flame with sodium chloride) have been superposed on those of the twilight radiation. The coincidence is absolute and remains so, whatever the interferometer used.

The D lines might be expected also in the night sky spectrum, on account of the presence of a yellow radiation having the proper wave-length (Slipher, Dufay, Cabannes). Their intensity would be only enhanced during twilight, probably by resonance excitation. In order to ascertain that this is so, the yellow radiation of the night sky has been studied (exposure: 11 hours, night almost without any moonlight), with one of the devices previously used for the twilight radiation. Rings perfectly clear, although less contrasted, have also been photographed under these conditions (Fig. 3). They are absolutely identical with those from the twilight doublet. In the two cases, the ratio of the intensities of the components D_2 and D_1 seems to have the normal value 2 : 1.

FIG. 3.

INTERFERENCE PICTURE OF THE NIGHT SKY YELLOW RADIATION (0·15 mm. ÉTALON).

These observations bring out the first decisive proof of the existence, in the high atmosphere, of an element distinct from the normal constituents of the air.

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March 21.

Adsorption Potentials at Polar Liquid-Liquid Interfaces

A GREAT deal of work has been done by Höber, Cremer and many other investigators on the so-called 'oil-potential', that is, the potential difference (P.D.) between two aqueous solutions, separated by some water-insoluble organic fluid. The latter is for abbreviation called the 'oil'. The simplest type of such a cell is the following, a 'concentration cell':

Electrolyte, c_1, in water/'oil'/same electrolyte, c_2, in water. $c_1 > c_2$.

It has been generally assumed that the electrolyte involved diffuses very rapidly from the water into the oil so that the P.D.'s observed refer to a state of *partition equilibrium* of electrolyte immediately at the phase boundaries and of stationary diffusion inside the oil. From these assumptions the following formula has been derived for a (1–1) electrolyte:

$$\text{P.D.} = V = \frac{U_- - U_+}{U_- + U_+} \cdot \frac{RT}{F} \ln \frac{c_1}{c_2}$$

where U_- and U_+ are the mobilities of the ions in oil. However, the P.D.'s actually reported at different c_1 and c_2 often show a very poor agreement with any logarithmic formula. A great number of measurements have forced us to the conclusion that this classical theory is not consistent. In fact, we have been led to a different view.

We suggest that a great many of the 'oil potential' measurements, recorded in the literature, do not refer to a true partition equilibrium of the electrolyte on both sides of the interfaces, but only to an *ion adsorption equilibrium* between the aqueous phases

and the interfacial layer. This should always be the case, when inorganic electrolytes are used and no special care has been taken to attain partition equilibrium, for example, by prolonged shaking of the phases. If, on the other hand, partition equilibrium is secured, P.D.'s are obtained different from the ion adsorption equilibrium P.D.'s and not so easily reproducible as these. The stability, the reproducibility and reversibility of the ion adsorption equilibrium P.D.'s within a few millivolts seem to indicate that the partition equilibrium of the electrolyte is not achieved even after a considerable time, even in the outer oil layers.

The interface oil/water can safely be assumed to consist of a single layer of 'oil' dipoles, the hydrophilic end groups pointing waterwards. If these are *negatively* charged (for example, CN, CHO, OH, NO_2, Cl), they should attract a monomolecular layer of positive ions, which are in turn coated by a diffuse cloud of negative ions. In a 'concentration cell' containing such an oil between dilute solutions of an electrolyte, the more concentrated solution should be the negative pole (as for the reversion of the effect at high electrolyte concentrations, see below). The P.D. should, moreover, be more dependent on the individual properties of different cations than those of the different anions. If an oil with *positive* hydrophilic end groups (for example, NH_2) is used, the conditions are reversed: concentrated electrolyte solutions are positive against dilute ones, and specific anion properties are prominent. These facts were discovered by Beutner and explained by him from a classical point of view as due to the 'acid' or 'alkaline' nature of the oils, but also non-acid oils like $ArNO_2$ and ArCl ($Ar = C_6H_4$) behave like Beutner's 'acid' oils.

We have derived the following approximate expression for the P.D. of each interface c–n (1–1) electrolyte in water/oil, the total P.D. being the difference of two such expressions:

$$V = V_0 + \Theta V^1 + \frac{2RT}{F}\sinh^{-1}\Theta\sqrt{\frac{K}{c}}\,;\ \Theta = \frac{c}{c+c_0}\,;$$

where R, T, and F have their ordinary meanings, V_0 is a characteristic of the oil and V^1, K, and c_0 are constants of both the electrolyte and the oil; c is the electrolyte concentration in water and Θ the fraction of the interface covered with ions. The second formula is simply the Langmuir adsorption isotherm.

Our experiments are in good agreement with the predictions of this formula. When the concentration c is raised, $\partial V/\partial \ln c$ (which should be a constant according to the classical theory) first rises to a maximum, then decreases and in several cases even passes through zero and changes its sign, as, for example, for acetophenone with potassium chloride in water at $c = 0{\cdot}02$.

Methylene blue chloride, which is very insoluble in $ArNO_2$ and ArCl, will, if added to one side of a cell with one of these oils, give large negative P.D.'s amounting to more than 200 mv. The V ($\log_e c$) curve is certainly not linear and for $ArNO_2$ it is in one part more than twice as steep as would be possible by any classical formula. However, the P.D.'s are well described by the above formula and agree fairly well with the Θ's calculated from the figures of Gibby and Addison[1]. From the classical point of view it is quite inexplicable that, for example, $(C_2H_5)_2NH.HCl$, which is certainly about 10^4 times more soluble than methylene blue chloride in these oils, will give P.D.'s smaller by several orders of magnitude.

The addition of a non-electrolyte to one side of a symmetrical oil cell will often produce a high P.D. If $ArNO_2$ is used, dilute solutions of iodine and mercuric cyanide give positive potentials, di-ethyl sulphone, acetaldehyde, methyl cyanide and others give negative potentials, varying between 30 and 200 mv. This we ascribe to a change in the electrical moment of the interface by adsorption of non-polar or di-polar molecules.

The ion adsorption equilibrium P.D.'s may play a part in physiology, for example, in the mechanism of the olfactory and gustatory systems and the activity of local anesthetics, and may therefore be well worth studying. In contrast to the partition equilibrium P.D.'s they are distinguished by good and rapid reversibility. They are, moreover, sensitive to very small amounts of certain substances (even in concentrations of 10^{-7} mol.).

A full report of our investigations, which are proceeding, with additional support for our views, will be published elsewhere.

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[1] *J. Chem. Soc.*, 119 (1936).

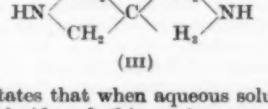
Amino-derivatives of Pentaerythritol

TETRAMINO-TETRAMETHYL-METHANE, $C(CH_2NH_2)_4$, was first prepared (in the form of its salts) by Govaert[1] by heating tetrabromo-pentaerythritol, $C(CH_2Br)_4$, with alcoholic ammonia in sealed tubes. This preparation has recently been repeated by van Alphen[2], who has isolated the free base and prepared various derivatives. The method of preparation is unsatisfactory, however, as the quantities of the tetrabromo-compound employed are limited by the use of sealed tubes, and the yield is low.

We have been investigating the amino-derivatives of pentaerythritol and their synthetic uses for some time, and have worked out a method for the speedy preparation of the tetramine in quantity.

When tetrabromo-pentaerythritol is heated with sodium *p*-toluene sulphonamide, $C_7H_7SO_2NHNa$, the tetrasulphonamido-compound (I), of m.p. 248°, is obtained in good yield, and on treatment with sulphuric acid is readily hydrolysed to the required tetramine. The latter can be isolated as the di-sulphate (II), which is almost insoluble in water.

$C(CH_2NHSO_2C_7H_7)_4$ (I) $\qquad$ $C(CH_2NH_2)_4.2H_2SO_4$ (II)

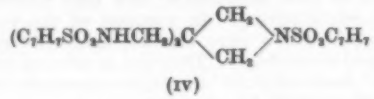


(III)

Govaert states that when aqueous solutions of the tetrahydrochloride of this amine are evaporated, ammonium chloride is broken off with the formation of the dihydrochloride of the spirocyclic diamine (III). We find, however, that the tetrahydrochloride can be recovered unchanged after it has been submitted to the following processes: (*a*) evaporated with water for 36 hours, (*b*) boiled with hydrochloric acid under reflux for 20 hours, (*c*) heated with hydrochloric acid in a sealed tube at 160° for 5 hours.

Methylation of the tetramine readily yields the octa-methyl compound, $C(CH_2N(CH_3)_2)_4$, which even with an excess of methyl iodide gives the bi-quaternary iodide $C(CH_2N(CH_3)_2)_3[CH_2N(CH_3)_3I)_2$: our attempts to prepare the quadri-quaternary iodide, $C(CH_2N(CH_3)_3I)_4$ have not at present succeeded.

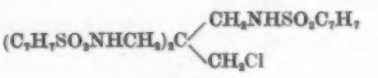
The preparation of the tetrasulphonamide (I) gives a small quantity of a trisulphonamide, $C_{26}H_{31}N_3O_6S_3$, of m.p. 214°, as a by-product. This compound has apparently the 4-membered ring structure (IV): hydrolysis with sulphuric acid opens the ring and gives the monohydroxy-triamine (V). Hydrochloric acid also



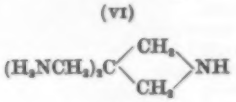
(IV)

$$C(CH_2OH)(CH_2NH_2)_3$$

(V)



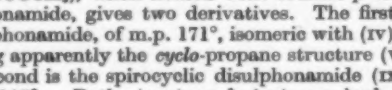
(VI)



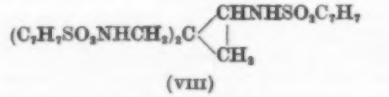
(VII)

opens the ring giving the chloro-compound (VI), which on complete hydrolysis followed by steam distillation undergoes ring closure again to give the monocyclic triamine (VII).

Monoacetyl-tribromo-pentaerythritol, $C(CH_2Br)_3(CH_2OCOCH_3)$, when heated with sodium *p*-toluene sulphonamide, gives two derivatives. The first is a trisulphonamide, of m.p. 171°, isomeric with (IV), and having apparently the *cyclo*-propane structure (VIII): the second is the spirocyclic disulphonamide (IX), of m.p. 185°. Both (VIII) and (IX) on hydrolysis



(VIII)



(IX)

with hydrochloric acid followed by steam distillation give the spirocyclic diamine (III). The constitution which we have provisionally allotted to the isomeric compounds (IV) and (VIII) is supported by the fact that their sodium derivatives on treatment with benzyl bromide give a dibenzyl and a tribenzyl derivative respectively.

The tetramine $C(CH_2NH_2)_4$ is now being used to investigate the stereochemistry of its spirocyclic organic and complex metallic derivatives.

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March 23.

[1] *Proc. Roy. Acad. Sci. Amsterdam*, **37**, 156 (1934).
[2] *Rec. Trav. Chim.*, **57**, 265 (1938).

Purified Uricase

IN the attempt to isolate the enzyme uricase from pig liver, I have obtained a preparation 550 times purer than the enzyme powder used as starting material. The purified preparation contains 0·15–0·18 per cent Fe, 14·4 per cent N, traces of copper, and no cobalt or manganese. It is almost colourless, and therefore is not a hæmin derivative. It is insoluble in water, almost insoluble in phosphate buffer *p*H 7·4, and soluble in borate buffer *p*H 10. Truszkowski[1] has already shown that uricase is soluble in alkaline solution.

The highest specific activity obtained, as measured by the oxygen uptake during the oxidation of uric acid in manometers, is 85 c. mm. per mgm. enzyme per minute as compared with a value of 0·15 c. mm. per mgm. per minute for the powder used as starting material. The test is arranged as follows: The main chamber of the manometer vessel contains 1·0 c.c. *M*/5 borate buffer *p*H 9 and 1·5 c.c. enzyme preparation plus water. The potash tube contains 0·2 c.c. 10 per cent caustic potash, and the side bulb 2·24 mgm. uric acid (as *M*/30 lithium urate). The gas space contains pure oxygen and the oxygen uptake is measured at 38° over a period of 30 minutes.

If it is assumed that the catalytic activity of the enzyme is due to the iron (although this has not yet been proved), then 1 mgm. iron brings about the reaction of 57,000 c. mm. oxygen per minute.

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[1] Truszkowski, R., *Biochem. J.*, **29**, 92 (1934).

Lactoflavin in the Eyes of Fish

SOME years ago we found[1,2,3] that the retinal pigment epithelium of the eyes of a number of fish contained relatively large amounts of flavin. Liver and kidney, which are known to be the materials richest in flavin, contain about 20 γ flavin per gm. tissue, while an approximate calculation of our results indicated in the pigment epithelium of some fish eyes 500 γ flavin per gm. tissue.

Flavin occurs in tissues almost entirely combined with protein as an enzyme which does not show the characteristic fluorescence of flavin and is not dissociated at neutral reaction. It was, therefore, a surprising observation that flavin of the pigment epithelium showed green fluorescence in water extract and was almost completely dialysable[2,3]. When the eye of a freshly killed fish was frozen in acetone-carbon dioxide mixture and cut by a meridional section the flavin contained by the pigment layer could be directly observed in the fluorescence microscope[4]. The spectrum of the green fluorescence light was identical with that of the flavin. The flavin from haddock eyes was also isolated and identified by Karrer[5] as lactoflavin. From these observations we concluded that flavin in the eye occurred in the free state or in the form of a highly dissociated protein compound but not as flavin enzyme. Thus the eye is the only tissue known which contains flavin mostly or entirely in the free form. Otherwise free flavin occurs only in milk and urine[6].

There was one detail of the problem not clear yet, namely, the question whether flavin in the fish eye originally occurs in the form of lactoflavin or as its

phosphoric ester. The latter compound would show the same fluorescence as flavin itself, but during the isolation process it might have lost the phosphoric acid group.

Recently Emmerie[7] has shown that flavin can be easily separated from flavin phosphoric acid by means of certain solvents. Benzyl alcohol, for example, dissolves flavin[8] but not the flavin phosphoric ester.

The application of this simple principle to the present problem showed us soon that the flavin of fish eyes was free flavin and not flavin phosphate. The eye of a big cod was detached immediately after killing, frozen in solid carbon dioxide, and the separated retina and pigment layer were extracted by grinding with ice water. By shaking the sharply centrifuged yellow solution with benzylalcohol three times the flavin was completely extracted. When lactoflavin phosphoric acid* was added to the water extract of the pigment layer of another eye it remained in the water phase after a similar treatment with benzyl alcohol.

The occurrence of free flavin in the eye suggests that flavin phosphate taken up with the food is dephosphorylated for its deposition in the eye. According to Kuhn[9], free flavin may also form an active compound with the protein part of flavin enzyme. This compound, contrary to the flavin enzyme, which is a flavin phosphate protein compound[10], is highly dissociated into its inactive components. The occurrence of free flavin suggests, therefore, that its function in the eye may be not that of a redox catalyst but that it may take part in the visual processes by means of its photochemical properties[11,12], as fluorescence and light sensitivity.

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March 28.

* We are indebted to Prof. P. Karrer for the lactoflavin phosphate used in this experiment.

[1] Euler and Adler, *Svenska Vetenskapsakad. Arkiv f. kemi*, **11**, B, No. 21 (1933).
[2] Euler and Adler, *Z. physiol. Chem.*, **223**, 105 (1934).
[3] Euler and Adler, *Z. physiol. Chem.*, **228**, 1 (1934).
[4] Euler, Hellström and Adler, *Z. vergl. Physiol.*, **21**, 739 (1935).
[5] Karrer, Euler and Schöpp, *Sv. Vet. Ark. f. kemi*, **11**, B, No. 54 (1935).
[6] Euler, Adler and Schlötzer, *Z. physiol. Chem.*, **226**, 87 (1934).
[7] Emmerie, NATURE, **141**, 416 (1938).
[8] Greene and Black, *J. Amer. Chem. Soc.*, **59**, 1820 (1937).
[9] Kuhn and Rudy, *Ber. deutsch. chem. Ges.*, **69**, 2557 (1936).
[10] Theorell, *Biochem. Z.*, **275**, 344 (1935).
[11] Theorell, *Biochem. Z.*, **279**, 186 (1935).
[12] Zewi, *Finska Läkaresällsk. Handl.*, **80**, 923 (1937).

Spore Formation in a *Vibrio*

WHILST nitrate reduction is a property common to a large group of bacteria belonging to very divergent genera (*Micrococcus*, *Pseudomonas*, *Bacillus*, etc.), all investigators who have thoroughly studied the important natural process of sulphate reduction agree that the causal organism is in all cases the strictly anærobic typically vibrio-shaped bacterium first described by Beijerinck in 1895[1]. It is true that the strains isolated sometimes show slight mutual differences which have led to the creation of one or two separate species or varieties, but this circumstance does not detract from the remarkable fact that these strictly anærobic representatives of a genus which until now has generally been considered to be non-spore-forming (apart from a few quite equivocal cases in the older literature) are almost universally distributed in Nature.

Seen in this light, it seems worth reporting that during investigations carried out in the last six months, decisive proof has been obtained that spore formation occurs in *Vibrio desulfuricans*. This fact has first been ascertained for pure cultures of the thermophilic variety earlier described by Elion and by Baars. It was then found that soil, canal and ditch mud, and sewage after having been heated for 30 minutes in boiling water, readily yielded active cultures of sulphate-reducing vibrios, when inoculated into the usual lactate enrichment medium both at 55° C. and at 30° C. In these cultures various morphological variations occur leading ultimately to the formation of spindle-shaped or slightly bent cells with sub-terminal, highly refractive spores about $1{\cdot}7 \times 1{\cdot}3\mu$ in size. Subcultures could be obtained by transferring these original cultures after they had been heated in boiling water for an hour. Cells in these cultures were the typical actively motile vibrios and spirals. Pure cultures obtained by repeated plating continue to produce spores when grown in various media in the temperature region between 45°–55° C. However, continued cultivation in the lactate medium at temperatures below 40° C. makes the cultures rapidly asporogenous, and this circumstance may well be responsible for the fact that spore formation in this species has been entirely overlooked until now, even by such a highly competent bacteriologist as Beijerinck.

The new generic name *Sporovibrio* is proposed for the sporulating, anærobic, Gram-negative, curved bacteria of this type.

The circumstance that under certain conditions cultures of *Vibrio desulfuricans* show a perfect and very regular spirillum-shape—hence the name of *Spirillum desulfuricans* as originally proposed by Beijerinck—makes it seem worth while to carry out renewed investigations regarding the spore-forming ability of other representatives of both the genera *Spirillum* and *Vibrio* (*Vibrio choleræ* !).

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Delft. March 28.

[1] Beijerinck, M. W., *Centr. Bakt.* (ii), **1**, 1–9, 49–59, 104–114 (1895). For a review of later publications the reader is referred to J. K. Baars, "Over sulfaatreductie door bacteriën" (Delft, 1930); see also H. J. Bunker, "A Review of the Physiology and Biochemistry of the Sulphur Bacteria" (London, 1936).

Ounce Molecular Weight of a Gas

IT does not appear to be generally recognized that an 'ounce molecular weight' of a gas will fill 22·4 cubic feet under a pressure of one atmosphere and at 0° C. This relationship is very useful as a starting point in many calculations of gas quantities in English units, and it might well be inserted in textbooks of physics and chemistry at the same time as the more conventional statement involving gram-molecular and litre units is presented.

The existence of this relation must have been noted by various workers, but it has undoubtedly not received the prominence and general use which it deserves. Since noting it myself independently in 1920, I have always found that its existence and use have been regarded as surprising and novel by any to whom I have mentioned it, until recently when I have been informed that the relation has in fact received text-book publication and indeed appears in the form of a problem set on p. 999 of Partington's "Textbook of Inorganic Chemistry".

It is additionally interesting to observe that the volume of an 'ounce molecular weight' of gas under N.T.P. conditions may conveniently be visualized, within an accuracy of one half per cent, as the volume of a carpet of gas 15 feet square and one tenth of a foot thick: the weight of this quantity of oxygen is two pounds.

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Salaries in Soviet Universities

IN estimating the income and standard of life of Russian professors, Dr. L. H. Callendar, in NATURE of February 12, has been influenced by the two misconceptions most frequently held by foreign visitors to the U.S.S.R. One is an undue pessimism in gauging the true value of the rouble, due to the fact that a foreigner always comes up against the most expensive items in the Soviet citizen's budget; and the other is the fact that if a professor earns 1,200 roubles a month, his wife will most certainly be earning at least half that sum. As I have just returned from more than five years' residence in the U.S.S.R., I can guarantee the authenticity of the following figures, which enable a comparison to be made of the standards of life in the two countries. The distribution of items is, of course, more or less arbitrary.

The average income of a Soviet professor is greater than Dr. Callendar states. Those whom I knew were all earning at least 1,500 roubles a month, but I shall assume an income of 1,200 roubles and a wife's income of 600 roubles, and shall compare the expenditure of a Russian family, consisting of husband, wife and two children, earning 1,800 roubles a month with that of an English professor's family with a salary of £100 a month or £1,200 a year. The official equivalent of 1,800 roubles is £70. To facilitate the comparison, I assume that both families live in flats.

U.S.S.R. (Kharkov, Ukraine)	per month roubles
rent and services (3-room flat with bath, kitchen and telephone)	120
central heating (yearly average)	20
taxes and health insurance	50
4 per cent. State loan	150
clothing	250
laundry	50
food and household	700
cigarettes	100
1 servant	60
sundries	300
	1,800

England (London)	per month £	per ann. £
rent and rates (5-room flat with bath and kitchen)	15	180
coal, light, telephone	4	48
income tax	12	144
life insurance (5 per cent of income)	5	60
clothing	8	96
laundry	1	12
food and household	24	288
tobacco and cigarettes	2	24
2 servants	8	96
education	7	84
doctor and dentist	2	24
sundries (car, etc.)	12	144
	£100	£1200

Education and medical service are free to all in the U.S.S.R. The clinics are served by the best specialists, and I have not found them overcrowded; for example, I have never had to wait more than 15 minutes at the dentist's, even if I came without an appointment. Moreover, urban transport, which is very expensive in England, costs practically nothing in Russia. In most cases a professor has a car at his disposal.

The monthly consumption of food, comprised in the 700 roubles mentioned in the list, includes the following:

Milk	50 pt.	Bread	40 lb.
Butter	20 lb.	Potatoes	100 lb.
Eggs	150	Vegetables	100 lb.
Meat	20 lb.	Fruit	50 lb.
Fish	20 lb.		

The items here listed cost 500 roubles in 1937 and refer to goods of the best quality, which are well up to English standards. The prices are falling steadily.

Cheap clothes are of poor material and good clothing is expensive. Scientific men and their families usually prefer a small assortment of good quality. Dress suits are not worn except by waiters.

Holidays are usually spent in the Caucasus or on the Black Sea coast, which are equivalent to Switzerland and the Mediterranean.

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30, Clifton Gardens, W.9.

A Binocular Illusion

IF an observer views a piece of linoleum, or pavement, marked out as a checkerboard in light and dark squares, it is possible by causing the lines of vision of the two eyes to converge, that is, locating the fixation point, above the linoleum, to produce the impression that the pattern is raised above the level of the floor, and that it is on a smaller scale than that of the actual linoleum. This occurs when the images of two neighbouring dark squares fall on the corresponding points of the two retinas. A still smaller pattern at a still higher level may be produced when the images of two dark squares, separated actually by two light and one dark square, are caused by suitable convergence to fall on corresponding points of the two retinas.

This illusion is probably known to many, but I can find no description of it in any general or ophthalmic physiology I have been able to consult; and it may be of interest that the phenomenon was brought to my notice by a boy aged nine years. He had discovered it quite independently for himself.

The raised patterns thus produced are seen to shift as the observer moves his head, as may be easily confirmed geometrically.

HENRY H. DIXON.

School of Botany,
Trinity College,
Dublin.
March 22.

Some Observations on the Rotating Pendulum

THE observations by Lythgoe[1] on the 'rotating pendulum' are almost entirely in accord with the hypothesis that the 'latent period' of vision varies in the same sense as the concentration of photochemical substance in the retina of the eye, and is controlled mainly, if not entirely, by this concentration. The concentration of photochemical substance is decreased (*a*) by a general increase in illumination of the field of view; (*b*) by the contemporaneous presence of one or more glare sources in the field of view; (*c*) by the previous presence of glare sources in the field of view. In case (*c*), of course, the concentration of photochemical substance is steadily returning to its equilibrium value in the absence of glare sources.

Lythgoe has found a relative decrease in the latent

period when any one of these three conditions is applied to one eye of a subject. The case of dark adaptation of one eye does not appear to fall into line with this hypothesis, though more exhaustive experimental work might clear away the discrepancy.

If the above hypothesis is true, the observations of Lythgoe are of considerable interest, as they would provide a simple and instantaneous measure of the concentration of photochemical substance in the retina of the eye.

B. H. CRAWFORD.

National Physical Laboratory,
Teddington.
March 31.

[1] Lythgoe, R. J., NATURE, 141, 474 (1938).

Clay in a Vegetable Diet

Messrs. Lawson and Moon record in NATURE of January 1 (p. 40) the eating of clay by Quetchua Indians from Lake Titicaca, South America. A similar clay is eaten by the Baganda, who are also vegetable eaters, their staple food being plantains and sweet potatoes. The use of the clay appears in this case to be confined to pregnant women and is eaten after work almost as a sweetmeat, the clay having first been smoked in the hut fire.

G. AP GRIFFITH.

Kampala,
Uganda Protectorate.
Feb. 22.

Points from Foregoing Letters

COMMENTING on the proposed Society for the study of the Social Relations of Science, Prof. F. Soddy stresses the need of paying attention to the working of the monetary system and for strong leadership on the part of scientific workers.

Using new methods of applying constant lateral pressure to monomolecular surface films, Dr. J. H. Schulman, E. Stenhagen and Prof. E. K. Rideal have studied the formation of complex films by injecting dilute solutions of substances such as cetyl sulphate and digitonin into the substrate (water solution) upon which a film of cholesterol is spread. They find that the increased area of the film due to penetration of the second substance is, under controlled conditions, in a simple ratio (1 : 1, 1 : 2 and 1 : 3), depending upon the structure (ring or chain) of the organic molecules involved. Several factors apart from surface pressure, namely, bulk concentration and *p*H, affect the formation and stability of the complex surface film.

The ratio of the initial intensities of the two (presumably) isomeric radioactive forms of rhodium, with periods of 44 and 244 seconds, obtained by bombardment of rhodium with neutrons, are deduced by Dr. B. Pontecorvo from the total activity: (*a*) with a source of radon plus beryllium in the presence of paraffin, and (*b*) with radon plus beryllium placed on the axis of the cylinder of rhodium in the absence of paraffin. In the first case the ratio was eleven, agreeing with that found by Segrè. In the second case (where the mean energy of the neutrons was less than 10^6 e.v.) the ratio found was six.

The generalization that mesomeric systems may be readily formed from others closely related to them throws light, according to Prof. J. Kenner, on many organic reactions such as the formation of azoxybenzene, transition from methyl diazohydroxide to diazomethane, the facile oxidation of nitroso-benzene to nitrobenzene, the formation of unsaturated systems such as stilbene from dibenzyl, the various syntheses of polyenes, etc.

When oxygen is bombarded with deuterons (of 2 M.e.v. energy) two radioactive substances are produced, one with a period of 90 seconds which has been identified as due to fluorine of mass 17 and another with a period of 120 minutes. Chemical separation shows this to be due to an isotope of fluorine of mass 18, according to T. Yasaki and S. Watanabe. The upper limit of the energy of the positrons which it emits is 0·7 M.e.v., and the authors discuss the possible nuclear reactions by which it may be formed.

Photographs of twilight spectra and interference pictures of the twilight yellow radiation are submitted by R. Bernard to prove the presence of sodium in the high atmosphere. The *D*-lines of sodium can also be detected in the night sky spectrum.

The electrical potential difference obtained when two aqueous salt solutions of different concentrations are separated by a non-miscible oily solution are due, according to G. Ehrensvärd and L. Gunnar Sillén, to absorption potentials (that is, to the accumulation of oppositely charged ions on the two sides of the oil-water interface), rather than to the difference in the concentration of the ions in the bulk of the liquid. The authors submit a formula which, they state, agrees with the experimental results, and suggest that absorption potentials play a part in taste and smell sensations.

Dr. F. G. Mann and A. Litherland discuss the preparation and relationships of various amino-derivatives of pentaerythritol, including tetra-sulphonamido-, bi-quaternary iodide-, and chloro-compounds.

The preparation of the enzyme uricase in a greatly purified form is reported by Dr. J. N. Davidson. The purest preparation contains 0·15–0·18 per cent iron and has a specific activity, under stated conditions, of 85 c.mm. per mgm. enzyme per minute.

E. Adler and Prof. H. v. Euler find that the lacto-flavin, extracted by water from the retina and pigment layer of the eye of a codfish, is not taken up by benzyl alcohol when shaken with that solvent. They conclude that the pigment is not in the form of a phosphoric ester, serving as oxidation-reduction catalyst, but occurs in the form of free flavin, which by its fluorescent and light-sensitive properties may take part in the visual processes.

Spore formation is reported by Dr. R. L. Starkey in *Vibrio desulfuricans*, the bacterium which reduces sulphate to sulphide. The temperature of incubation seems to exert a marked effect on sporulation. This is claimed to be the first definite evidence of spore-formation by bacteria of the morphological group to which this and also the cholera organism belong.

Research Items

Clactonian Implements

ON the basis of excavations at Jaywick Sands, Essex, in 1934 Mr. Kenneth P. Oakley and Mrs. Mary Leakey have discussed in detail the position of the Clactonian industry with special reference to the fauna and geological evidence of the Clactonian channel (*Proc. Prehist. Soc.*, 1937, **3**, 2). The deposits of the foreshore exposure of Pleistocene deposits at Clacton and Lion's Point were made famous through the investigations of Mr. Hazzledine Warren, and the gravels in the Clacton channel have yielded a contemporary palæolithic flake industry, which was recognized by the Abbé Breuil as identical in style with that of the gravels of the Middle Pleistocene of Mesvin, Belgium. To this the name of Clactonian has been given, and the style has since been recognized in many localities both in Britain and on the Continent. It is a widespread culture, possibly of Asiatic origin, and probably ancestral to Mousterian. The industry of the type station, Clacton-on-Sea, represents neither the earliest nor the latest stage, and it is important to establish its exact position in the Lower Palæolithic sequence. This involves an exact correlation with the terrace succession of the Lower Thames Valley. Warren has claimed that the Clacton deposits belong to the earlier part of the Taplow Terrace group, whereas Breuil has correlated them with the early Boyn Hill, or 100 ft. terrace. As a result of the present investigations it is concluded, especially on the evidence of the fauna, that the Clacton channel deposits belong to the same inter-glacial period as the 100 ft. terrace of the Lower Thames. The flint industry points to the same conclusion. A comparison of the industries of the two leads to the view that the type Clactonian industry is intermediate between the Clactonian industry of the Lower Gravel and the flake industry represented in the Middle Gravels of the 100 ft. terrace at Swanscombe. As regards the geological evidence, it is clear that the low level of the Clacton channel requires special explanation, if, as the evidence suggests, they post-date the Lower Gravel but predate the Middle Gravel. The only feasible explanation is an interruption of the aggradation of the gravels of the 100 ft. terrace by a phase of rejuvenation of the river, which resulted in the cutting of a sunk-channel in the lower reaches of the valley.

Cones from the Dutch East Indies

THE posthumous work of Dr. Ph. Dautzenberg on the genus *Conus* (Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique. Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Hors Série, Vol. 2, Fascicule 18. Gastéropodes marins. 3—Family Conidae, 1937) was completed by Dr. E. Leloup and is now issued in a very handsome volume, a companion to the former work on the families Terebridæ and Mitridæ of this same series. There is an enormous amount of work involved here, with pages of carefully noted synonymy and criticisms, and some beautiful coloured plates. In 1937, Mr. J. R. le B. Tomlin published his catalogue of recent and fossil cones (*Proc. Malacol. Soc.*, **27**; 1937) and there is not one species of those from the Dutch East Indies not included in this list, there being no new species. The genus *Conus* is so well known to conchologists that this is not at all surprising. The two authors are not always in complete agreement as to the authority for the species, although in most cases these coincide.

Phyllirhoidæ of the John Murray Expedition

THESE are described by H. G. Stubbings (John Murray Expedition 1933–34. Scientific Reports, **5**, No. 1; 1937. British Museum (Natural History)). The family is represented by five specimens belonging to a new species of *Cephalopyge*, namely, *Cephalopyge arabica*. It is interesting in that it incorporates characters hitherto regarded as diagnostic of one or other of the two subgenera of *Cephalopyge* recognized by Thiele (1931). A detailed description of this new species is given and also a systematic revision of the genus. The family Phyllirhoidæ is divided by the author into two genera, *Phyllirhoë* and *Cephalopyge*, and a key is given to the species of the latter genus, of which there are four now recognized, two of which possess a radula and two, including *C. arabica*, are without it. Their distribution is almost world-wide in tropical and subtropical waters. They are all very small and all the records for which the time of year is known lie within the period autumn to winter in both northern and southern hemispheres. Mr. Stubbings suggests that it is probable that the species become adult, when they are a size most likely to be captured, during the autumn, and live through the winter. "The next generation would then be undergoing its larval development during the following summer when food conditions would be at their best." The specimens of *C. arabica* are from localities near the equator where there is no winter as such. They were obtained, however, during the period of the north-east monsoon, which is the coldest period of the year in the Arabian Sea.

Origin of Octoploid Wheat

THE origin of an octoploid wheat has been described by Dr. G. S. Bhatia (*J. Genetics*, **35**, No. 3). Reciprocal crosses were made between *Triticum vulgare* var. *graecum* and a new variety of *T. dicoccum* (Khapli emmer) from the Central Provinces of India, which is described under the name var. *Indicum*. It differs from other Indian varieties in having pubescent glumes and three awns per spikelet. The writer concludes that emmer wheats originated not in Abyssinia but in the Eastern Mediterranean region between Caucasus and Palestine. Khapli × *vulgare* gave 60 per cent setting of grain while the reciprocal gave only 40 per cent, the latter seeds being also much smaller. From 30 seeds of Khapli × *vulgare* only one germinated and it soon died. Three seeds from *vulgare* × Khapli were much larger than the rest and were sown separately. One of them germinated to produce the sturdy octoploid. The remainder produced 11 pale seedlings, all of which died within two months. The octoploid with 56

chromosomes probably came from a diploid egg of *vulgare* uniting with a haploid male cell from *T. dicoccum*. This plant resembles the Khapli parent in habit and grain colour, but in the shape of the glumes, ears and awns it resembled the *vulgare* parent. The plant showed regular meiosis with 28 bivalent chromosomes and produced good seeds.

Lintless Mutations in Cotton

A LINTLESS condition occasionally arises as a mutation in cotton. Seven types of lintless Asiatic cottons are described by Messrs. J. B. Hutchinson and P. D. Gadkari (*J. Genetics*, **35**, No. 2), originating in strains of *Gossypium Mollisoni* (*G. arboreum* var. *neglectum*), in different parts of India. It is shown that at least four independent genes are involved, two of which are complementary genes for glabrous lintless, in which the plants produce no hairs of any kind, and two complementary for hairy lintless. Three represent independent mutations at the same locus. No satisfactory evidence of linkage was found, but there was strong association of another kind between a lintless gene, in the Punjab type, and leaf shape. In one lintless type the plants have almost full strength when grown in the mild climate of Trinidad, but in Central India they are semi-lethal. The Punjab lintless type has in eight generations undergone a remarkable change in the homozygote from complete lethality to complete viability. How this change took place is not clear, but its relation to theories of change of dominance is discussed.

The Apple Scab Fungus

THE fungus *Venturia inaequalis* is the cause of one of the major diseases of the apple crop. Two main sources of infection have been recognized, namely, pustules of conidia upon year-old wood, and ascospores from perithecia upon dead leaves of the previous season. Mr. R. McKay now shows (*Sci. Proc. Roy. Dub. Soc.*, **21**, No. 57, 623; 1938) that a third source of infection in orchards at Glasnevin, Dublin, lies in bud scales which harbour the fungus. These provide a virulent source of conidia very early in the spring, when the young leaves first appear. It is possible that such a method of overwintering might explain many puzzling outbreaks of the disease in other regions. Attention of growers is directed to the control of bud infection by spraying with Bordeaux mixture or lime-sulphur. This is the usual method, but it should now be possible to apply it with more insight, and assess its action more exactly.

Secondary Causes of Earthquakes

Two papers have recently been published on the secondary causes of earthquakes. One, by V. Conrad (Union Geod. Geoph. Intern., Publ., Ser. A, fasc., No. 15, 118–123; 1937), deals with the effects of variations in atmospheric pressure. On a map of the epicentres of earthquakes in Hungary during the years 1919–28, plus signs are inserted at the epicentres when the pressure was rising during one or two days before the earthquakes and minus signs when the pressure was falling. The distribution of the signs in zones shows that the activity of the foci is affected by changes in atmospheric pressure. On the other hand, the earthquakes of the Menstrie and Invergarry districts in Scotland show no such effects (see NATURE of January 22, p. 167, for a note on similar zones in New Zealand). In the second paper (*Bull. Seis. Soc. Am.*, **28**, 15–22; 1938), R. Z. Kirkpatrick has examined the effects of tidal variations on the occurrence of 105 earthquakes recorded at Balboa, at the Pacific entrance of the Panama Canal. He finds that 30 earthquakes occurred within 1½ hours of low tide and 27 within 1½ hours of high tide. The average high tide for the year at Balboa is + 10·7 ft. and the average low tide − 10·5 ft.

Blue Solutions of Cobalt Chloride

MANY investigations have been carried out with the view of explaining the blue colour encountered with solutions of cobalt chloride under certain conditions. It has been suggested that the ion $CoCl_4^{--}$ is formed; also, that the colour is due to a different state of hydration of the cobalt ion. A recent paper by Pearce and Dawson (*J. Chem. Phys.*, **6**, 128; 1938) contains a new explanation based on observations of the effects of adding different concentrations of hydrochloric acid, alkali and alkaline earth chlorides on the absorption spectrum of cobalt chloride. It has been found that the characteristic band is widened by the added salt, and that the extent of widening depends directly on the ionic charge and inversely on the ionic volume of the added cation. This increased absorption of light and consequent colour change is found to bear an intimate relation to the degree of hydration of the added cation. Equimolal concentrations of added chlorides do not produce equivalent colour changes, indicating that the formation of complex ions of the type, $CoCl_4^{--}$, is apparently not an adequate explanation. In dilute solutions the cobalt ion is strongly hydrated and the sheath of solvent surrounding it prevents it from approaching closely to the chloride ions. When strongly hydrating ions are added, they attract solvent molecules and thus render it easier for the cobalt and chloride ions to approach under the influence of electrostatic attraction. Under these conditions it is assumed that the chloride ions exert a distortion on the electronic system of the cobalt ion, causing it to absorb at a different wave-length, that is, to exhibit a different colour.

Lantern Adaptor for Film Strips

IN recent years, optical lanterns and their accessory parts have undergone a number of improvements. A new device which has been submitted to us is Dance's Patent Adaptor, by means of which film strips can be projected by any lantern or epidiascope as simply as glass slides. Film strips have many advantages over glass lantern slides: copies are much cheaper, there is no fear of breakage, storage room is negligible and as many as sixty pictures may be sent through the post for 2d. As the size of the picture has been laid down by the British Standards Institution, use of the film strip instead of the glass slide is likely to increase. With the adaptor referred to are supplied seven glass slides, each capable of holding four frames or pictures of the film strip. By this means the teacher or lecturer is not held to the order of the pictures comprising the complete strip but can select his own pictures, either from one film strip or a number of strips, in exactly the same way as he now selects his lantern slides from a number of sets. There are usually from twenty-four to thirty pictures on a strip, and these can, of course, be projected in the order in which they occur on the strip

instead of cutting them up into sets of four. The whole adaptor, together with the glass slides, is packed in a box 7 in. × 5 in. × 2 in. in size. Particulars of the device can be obtained from Messrs. Pelly and Healey Ltd., 61/63 Blandford Street, W.1.

Precision Gauge for Measuring Liquid in Tanks

THIS gauge has been designed by Messrs. Negretti and Zambra in conjunction with the Production Department of the Iraq Petroleum Company for the measurement of bulk quantities of crude petroleum, or products derived therefrom, when contained in storage tanks of uniform cross-sectional area. It consists essentially of a manometer in which a mercury column is used to measure the equivalent weight of the head of oil. The gauge is rigidly mounted and two spirit levels are provided for levelling purposes. Other features include special illumination to obtain sharp definition of the mercury meniscus, vernier and scale for accurate measurement of the length of the mercury column, and thermometer for determining the temperature of the gauge. Each instrument is calibrated by the National Physical Laboratory. In addition, tables are supplied for correcting gauge readings to a standard temperature and for the conversion to equivalent weights of oil. All measurements are made from a fixed datum level and an overall accuracy within 0·005 inch is guaranteed. The range of the gauge is from 0 to 36 inches of mercury. The instrument facilitates measurement of oil in bulk and should find a wide application in the petroleum industry.

Pipe Thermostat

A PIPE thermostat has been designed by Messrs. Negretti and Zambra, which is intended for use where it is desired to operate certain mechanism whenever the temperature of the fluid in the pipe rises or falls outside predetermined limits. It is robustly constructed and is clamped to the outside of the pipe. Models are available to suit pipes from ½ to 6 inches in diameter with one of three temperature ranges: 0–100° F., 100–200° F. or 200–300° F. The minimum differential is ±2½° F. of the setting point.

Higher Magnetic Permeabilities

THE magnetic permeability of a substance is the ratio of the magnetic flux density through the substance to that through air for the same magnetizing force. In the *Bell Laboratories Record* of March, R. M. Bozorth tells how a substance has been found experimentally which has ten times the permeability of the best commercial permalloys available. Since the discovery, more than twenty years ago, that certain alloys of iron and nickel have remarkable magnetic properties, the factors which control this unusual behaviour have been very carefully studied with the object of still further increasing the permeability. The material found was a single crystal of permalloy which contained 66 per cent nickel. This was purified by heat treatment at a high temperature in hydrogen, then cut so that its permeability could be measured. It was heat-treated again and afterwards at a relatively low temperature in a magnetic field. After this preparation, the permeability of this crystal was 1,330,000 for a definite magnetizing force. Although at present it seems improbable that commercial use will be made of single permalloy crystals, some of the factors which make for high permeability, such as crystal orientation, heat-treatment and chemical composition are commonly used in manufacturing magnetic materials. Recently some factories have begun to roll transformer sheet so that the crystallographic directions are aligned in desired directions of easiest magnetization with respect to the dimensions of the sheet. There is a distinct possibility that heat-treatment in hydrogen at a high temperature and in a magnetic field at a relatively low temperature will in the future be of value commercially.

Radioactive Constants of Uranium and Radium

IN a short paper (*Anz. Akad. Wiss. Wien*, No. 3, 7; 1938), S. Meyer discusses the mutual consistency of recent determinations of the radioactive constants of uranium and radium. The sources used in such determinations are calibrated by comparison with one of the international radium standards. In 1934, the standards at Vienna and Paris were replaced by new ones prepared by Hönigschmid, who also prepared standards for other national laboratories. Intercomparison of the old and new standards has not revealed any significant difference between them; some of the new standards are a few parts in a thousand larger than the old ones, while others are smaller by the same amount. It is suggested that measurements be referred to the old Vienna and Paris standards, which appear to have exactly the same value. In terms of these standards, the number of particles emitted per second by one gram of radium is $3{\cdot}68 \times 10^{10}$. Owing in part to errors of calibration of the sources, the accuracy of this measurement is not more than 0·5 per cent. Measurements of the corresponding quantity have been made in the case of uranium by Schiedt and by Kovarik and Adams. In order to relate these to the constant for radium, they have to be corrected for the α-particles emitted by U II and by actino-uranium. It is shown that, while Schiedt's corrected value is consistent with the radium : uranium ratio found in old minerals, Kovarik and Adam's value is too low. These considerations suggest that the most probable values of the constants for U I and Ra are: half value period: U I, $4{\cdot}58 \times 10^9$ years; Ra, $1{\cdot}59 \times 10^3$ years; number of α-particles emitted per gm. per sec.: U I, $1{\cdot}214 \times 10^4$; Ra, $3{\cdot}68 \times 10^{10}$; Ra/U equilibrium ratio = $3{\cdot}3 \times 10^{-7}$.

Inclinations to Line of Sight of Non-Galactic Nebulæ

MR. F. G. BROWN has recently published a paper with this title (*Mon. Not. Roy. Astro. Soc.*, **98**, 3; Jan. 1938), his study being based primarily on the catalogue of the Herschel nebulæ north of declination −20°, measured at Heidelberg on plates taken with the Bruce 40-cm. portrait lens and the 70-cm. reflector. All non-galactic nebulæ of 2′ diameter and greater have been extracted and classified from this catalogue, a total of 593, and these reveal an apparent large excess of small inclinations to the line of sight. In addition, 109 other nebulæ within the area covered by the catalogue down to the limiting diameter reveal the same characteristic. Although E. Öpik suggested some fifteen years ago that photographic selection is responsible for the excess of small inclinations, Mr. Brown shows fairly conclusively that this is not so, and that there is probably a real systematic orientation of the planes of the nebulæ in space.

The Rivers of India

THE material welfare of the people of India has always been in unusual measure dependent upon the amount of water available for agricultural operations at the right season. This fact chiefly led Prof. M. N. Saha to devote his recent presidential address to the National Institute of Sciences in India to "The Problem of Indian Rivers", for, as he points out, 66 per cent of the population are peasants and a further 23 per cent are villagers mainly dependent on a rural economy. While the normal rainfall suffices in parts of India to nourish the prevailing agriculture, the fact remains that this must be supplemented wherever possible by storage in 'tanks', as in most of the Deccan, by utilization of subsoil water from wells, and by the great canal systems providing irrigation water from the large rivers of the Indo-Gangetic Plain and the eastern coastal plain. The distribution of population density, therefore, may be very closely correlated with those of rainfall and irrigable land. Prof. Saha cites the estimate that of the total rainfall 60 per cent is evaporated, and of the 40 per cent which passes to the ocean only 6–8 is used for irrigation. He pays tribute to the long-sustained interest of the Government in irrigation as leading to the huge total investment of 150 crores (more than 113 millions sterling) in new works and in repairs to old works; but he quotes the Central Irrigation Board's report that, of the 30 million acres irrigated from artificial canals, 8 million, lying chiefly in Bengal, Bihar and Orissa, are 'unproductive', that is, produce no profit for the irrigation authority.

The lateral movements of river beds on alluvial plains is of course recognized as a gradual process incessantly at work, and the same is true of the downstream migration of meanders. Nevertheless, there are reasons for believing that in northern India deep-seated crustal movements account for some of the more spectacular hydrographic changes. Prof. Saha gives examples of the effects of river change in this region. Pataliputra, the capital city of India from the sixth century B.C. until the fifth century A.D., owing its importance to its position at a focus of communications along five rivers, now lies buried 17 ft. beneath the modern Patna. Gaur, 160 miles north of Calcutta, which as Pataliputra's successor was estimated to have contained more than two million people in the fifteenth century, is now smothered in jungle. The suggestion is made that its evacuation was due to sinking, slight but sufficient to render it unhealthy. Moreover, such subsidence relative to surrounding deltaic land seems to merit investigation, since it is reported from Calcutta, where the level is said to have declined from 2 ft. to 4 ft. in the last two centuries, and this has called for pumping to assure the discharge of sewage. Finally, the well-known disastrous effects of river changes of the Ganges-Brahamaputra delta are cited, by which the eastward migration of live rivers has left the western areas seamed with channels intermittently filled, and so with abundant stagnant pools leading to malaria and decadence of the region. How far this natural process could have been prevented is uncertain; but it is claimed that in one section at least, the Burdwan division, which lost nearly half its population from malaria between 1860 and 1870, the harm was due to an artificial cause, the building of the railway embankment without proper study of the consequences to the hydrology.

In stating that construction of weirs and bridges has too often been undertaken after insufficient and too localized study of the rivers, Prof. Saha quotes Sir Francis Spring in his plea in "River Training and Control", that the State ought "by consistent, logical and well-organized research to learn something more definite than is now known about the physics of long reaches of rivers". This in the nineteenth century; only within the last decade has effect been given to the suggestion and so far only by two provinces. The Punjab has its Irrigation Research Institute at Lahore, and Bombay has installed a hydrodynamic research station near Poona. No such laboratory exists as yet in the eastern provinces, where the need for hydrological research would seem to be greatest.

Prof. Saha concludes his address with a striking vision of India regenerated, socially and economically, by a process of industrialization analogous to that now under way in the U.S.S.R. In reviewing the present backwardness of Indian labour conditions he attempts an assessment of energy expended, and finds the amount per head per year to be less than 90 of the units adopted (man-power 60, animal 10, steam and oil 10, electricity 7). This he contrasts with Japan, 6–8 times greater, and Norway, nearly 19 times greater. He notes the vast increase in Russian output of electricity from 15 units per head in 1919 to about 300 in 1937, with a corresponding increase in the proportion of industrial population; and he considers that this points the way for India. He then discusses the very high average cost of the half-million kilowatts of electric energy already installed in India, which represent only about 2·5 per cent of the hydro-electric resources, if Meares' estimate be accepted, and he cites cases of installations unduly costly owing to inadequate study. The time is therefore ripe, he submits, for a systematic survey of water-power resources following the Russian plan of attack, for he holds that cheap power will go far to eliminate the root cause of poverty in India. It may be noted, however, that he here leaves many sides of the population problem untouched.

Nevertheless, Prof. Saha has directed attention to certain facts that appear to be insufficiently appreciated: that rivers possess strong individuality in the character of their basins and in their regimens; that the proper unit of study is the entire catchment area; that the uses which they offer to man—power, transport, supply for irrigation and industry—as well as the menaces of flooding and silting, are all closely interrelated; and finally, that the dependence of the Indian people upon the rivers is so tremendous that the whole subject merits thorough investigation. In conclusion, it may be noted that the question of soil fertility is intimately bound up with those which he discusses. Systematic observation would appear to be requisite throughout each basin upon such matters as soil erosion on one hand and silting on the other, as well as on the variations in the depth of the water table and their bearing upon alkaline and other incrustations.

Soil Toxicity in the Dorset Heaths

A MEETING of the British Ecological Society, presided over by Prof. A. G. Tansley, was held on April 20, in the Department of Botany, Bedford College, Regent's Park, London, N.W.1. The entire meeting was given to consideration of the problems of soil toxicity and its amelioration in the Dorset heaths. The researches now in progress have come about as a result of observations and experiments initiated by Dr. M. C. Rayner in the Wareham neighbourhood in 1931 on the lands of the Forestry Commission now known as Wareham Forest.

A considerable tract of country around the town of Wareham in Dorset is occupied by heathland. Certain areas of this were acquired by the Forestry Commission and sown with several species of pine in 1924–27. These original sowings gave very poor results, the seedlings for the most part showing no growth or dying outright. In addition, there were many puzzling inconsistencies of behaviour.

The meeting was opened by an informal account by Prof. Neilson Jones of some of the characteristics, including that of apparent toxicity, associated with Wareham soil, and was followed by a general summary by Dr. Rayner of the field and laboratory researches at Wareham Forest that have led to the present situation. Some of the exhibits, relating to mycological and mycorrhizal problems arising from the field experiments, have an important bearing on the nutrition and healthy growth of conifers in cultivation, for example, those on Sitka spruce and Lawson's cypress.

The accounts of the work were supplemented by a large number of well-displayed demonstrations illustrating various phases of the research work in progress. Among these were demonstrations of the inhibition of seedling and fungal growth by soil factors, growth effects produced by the addition of raw cellulose to soils, epinastic curvature reactions induced by soil constituents, the incidence of 'fused needle' disease, and the effects on seedling growth produced by soil inoculation with humus or mycelium from pure cultures.

Also illustrated were the remarkable effects on growth brought about by the use of certain organic composts on Wareham soil, with some of the evidence supporting the hypothesis that led to their use and now put forward to interpret their action. Pure cultures of a number of mycorrhizal and associated soil fungi were displayed.

A general discussion followed inspection of the demonstrations, in which a number of visitors and members of the Society took part.

In his concluding remarks, Prof. Tansley pointed out that a meeting such as that just held, in which the Society visited an institution to hear about the research work in progress there, was an innovation; the results of the experiment led him to hope that other meetings of the kind would be arranged in the near future.

Faunistic and Hydrographic Changes

By B. Storrow, Dove Marine Laboratory, Cullercoats, Northumberland

THE following faunistic records are of interest in connexion with recent hydrographic changes as described in the reports of the International Council for the Exploration of the Sea. Abnormal activity of Atlantic waters around the north of Scotland will bring oceanic and western species into the northern North Sea. When this activity is followed by a southerly extension of the influence of the Norwegian sea the recent additions to the fauna can be expected to retreat to the Atlantic or to move southwards before the influence of the colder waters. In this southerly movement before the advance of cold conditions they will be followed by the fauna of the colder waters. Records of a mixed fauna may be found still farther south after a suitable interval. The above outlines the probable cause for the following records which have been obtained for the Northumberland coast. Unless otherwise stated, the specimens mentioned have been obtained from North Shields trawlers.

Geryon tridens Krøyer. 25–30 years ago this crab was commonly called the Fair Isle pilot by North Shields skippers, who did not find it in their trawls until reaching the vicinity of Fair Isle. To the best of our knowledge it has not been recorded for the waters off Northumberland. The first specimen was obtained April 29, 1935, 31 miles N.E. ¼ N. of the Tyne, which is to the east of Coquet Island. The second specimen was found on March 10, 1936, and the trawler had been fishing 10 miles N.E. ¼ N. off the Tyne. No further records were obtained until October 1937, and from then until the end of the year 49 specimens were brought to the Laboratory from trawlers fishing off our coast. Some of these crabs are living in our tanks.

Chimaera monstrosa L. As a general rule, North Shields trawlers do not get the rat-fish until reaching the latitude of Aberdeen or thereabouts, and then not frequently. One was taken 10½ miles N.N.E. of the Tyne, January 22, 1938.

Urophycis blennoides (Brünnich). The greater fork-beard has never been a local fish and its presence in the catch of a North Shields trawler was associated with fishing in more northerly waters and often in the vicinity of the Norwegian deep water. One was caught 14 miles east-north-east of the Tyne, June 15, 1936.

Pristiurus melastomus (Rafinesque). According to Smitt the black-mouthed dogfish has a wide range and has been taken occasionally off the Norwegian

coast and in the Skager Rack and Cattegat. One was taken in 42 fathoms east of Coquet Island, April 30, 1937.

Centrolophus niger (Gmelin). The black-fish of Couch is considered a fish of the Mediterranean and Atlantic. Occasional stragglers have been taken off our south coast and Day refers to specimens from the Northumberland and Yorkshire coasts. One of 56 cm. was taken on Berwick Bank, October 25, 1937.

Cetorhinus maximus (Gunner). It is generally supposed that the basking shark migrates northwards along the Atlantic seaboard as far as the Norwegian coast after its appearance off the west coast of Ireland in spring. Occasionally it enters the North Sea. One, 10 ft. 11½ in. in length, was caught in salmon nets, 2 miles off Souter, on June 13, 1934.

Ctenolabrus rupestris (L.). The goldsinny is found along the Atlantic coasts of Europe from the Mediterranean to Trondheim and in the southern Baltic. It has been recorded for Northumberland and Yorkshire, but not in our time. A specimen caught on July 3, 1935, 20 miles north-north-east of the Tyne, is living in the aquarium. Another was picked up on Whitley sands, January 31, 1937.

Maurolicus muelleri (Gmelin). The pearl-side has a wide distribution. According to Smitt, it has been found on both sides of the Atlantic and from the coast of Finmark to that of Sweden. It also enters the North Sea. It is far from common off our coast. Three specimens have been picked up on the sands of Cullercoats and Whitley Bay recently in March and April; one in 1936 and two in 1937.

Science and Industry

A SERIES of lectures arranged by the London Branch of the Association of Scientific Workers on the subject of science and industry has recently come to its conclusion. These lectures were arranged by the Association with the object of directing attention to the application of scientific methods and developments in industry, and the possibility of increased application; the allied question of the organization of research; and the question of the best types of scientific education to fit men for technical positions in industry.

The first lecture was given by Sir Richard Gregory. He opened with an enumeration of some of the outstanding benefits that science has conferred on society, and showed how the developments of industry have depended upon the developments of creative science. The extent, however, to which scientific discovery is used for industrial progress depends upon the capacity of industry to understand the results of research and the power to use them. The general principle that expenditure on science is a profitable investment may be said to have been conceded, but as yet science is not used as fully as it may be. Forty years ago the expenditure of the British Government on scientific investigation was about £45,000; at the present time the total amount is nearly two millions, of which the Department of Scientific and Industrial Research administers about £600,000. Sir Richard quoted a memorandum presented by the Parliamentary Science Committee, and supported its argument that the provision for scientific and industrial research in Great Britain is inadequate and that a bolder and broader financial scheme is needed.

Sir Richard went on to plead for the employment of men with scientific training and knowledge as directors and administrators. Industry suffers from administrators who have not a scientific outlook and do not realize the value of long-sustained expenditure on scientific research, although he admitted that it is difficult to find men who combine specialized knowledge on scientific and technical subjects with organizing or administrative capacity.

Sir John Russell traced the application of science to agriculture from the early investigation into artificial manures carried out on the same land now occupied by the Experimental Station at Rothamsted to the present day, when such research demands the knowledge of chemists, physicists, botanists, biochemists, pathologists, etc. The development of agriculture has not been devoid of chance discoveries, particularly in the development of wheat and in the use of such things as Bordeaux mixture, devised to scare away predatory boys. There has, however, been great advances in the knowledge and control of the processes of Nature as a result of the patient detailed work that has been carried out. Besides the effect of the well-known artificial manures, it has been discovered of recent years that traces of certain inorganic salts such as the compounds of cobalt and boron have a marked effect on the plant life and the subsistent animal life.

Under the title of "Science in the Chemical Industry", Major F. A. Freeth indulged in alternate attacks on and justification of the existence of industrial scientific workers. The attacks were, however, more of the nature of constructive criticism. That the existence of men of science is justified there is no doubt; but there is doubt whether they have the right attitude to their tasks. Men of science as a body lack rhetoric—they do not know how to capture the enthusiasm of the general public.

The chemical industry itself is the only industry that takes its name from the science on which it is based. It should properly be called the 'molecular industry', for it is chiefly the scientific study of the behaviour of molecules which forms the basis on which the large industries are built. Some of the heavy chemical industries date back for decades, but the modern organic chemist owes everything to the patient hard work of investigators which is continuing all the time. Fundamental scientific theory is required for any new development in the chemical industry, but before it can be put into practice it must be translated into terms of large-scale plant and teams of men, and there is often a considerable time-lag between the adoption of a new method and its achievement in practice.

Dr. E. A. Rudge spoke on the subject of training for the chemical industry and chemical engineering; and described an investigation he had conducted to find out the requirements of a number of chemical

industries by way of recruits to their scientific staffs. With the great increase in scientific control in industry there has arisen a demand for a varied army of scientific workers, ranging from routine semi-skilled testers to fully trained research specialists. By means of a questionnaire Dr. Rudge has gained information that shows the distribution of the demand for scientific workers in the different grades.

This investigation produced the following main conclusions. A large proportion of the chemical firms in the area investigated employ small laboratory personnel (less than ten employees). These small organizations commonly employ unqualified recruits, and it is in the main the larger laboratories that require graduates and research workers. A great preference is shown for recruits of about matriculation standard with a knowledge of industrial method and technique. For every graduate required for the specialized work of research development more than nine undergraduates are required for laboratory routine. The question of the training of these unqualified employees is one that requires greater co-operation between industry and teachers, especially in the technical colleges.

Dr. F. S. Sinnatt, speaking on the Fuel Research Coal Survey, said that the work of the Department of Scientific and Industrial Research can be divided into two sections: the utilization of coal, and the survey of the coalfields of Great Britain. Different types of coal are needed for use in coking, gas manufacture, steam raising, household use and hydrogenation; wide variation may occur in the composition of a seam within the area covered by one mine, with consequent changes in its suitability for these different purposes. The control of such variation is of primary importance to the consumer and must be the basis of any improvement in the utilization of coal.

As a result of the work already done, it can now be said about certain important seams in different coalfields that every major variation in the composition is known, and that it can be forecast for any spot within narrow limits.

The Waite Agricultural Research Institute, South Australia

THE Waite Agricultural Research Institute was established at Glen Osmond, near Adelaide, South Australia, in 1925, as a result of the late Mr. Peter Waite's gift to the University of Adelaide for the purpose of furthering the cause of education and research in agriculture and allied subjects. The total value of the bequest was estimated at £100,000.

The University Council decided that the principal objective of the Institute should be to enlarge the stock of knowledge relating to agriculture in the widest sense, and pass it on to those actively engaged in production, as farmers or pastoralists. Two chairs were established: one in agriculture and one in agricultural chemistry. Prof. A. E. V. Richardson was appointed Waite professor of agriculture and first director of the Waite Institute; Prof. J. A. Prescott was appointed Waite professor of agricultural chemistry. Since the commencement of active work early in 1925, the number of research workers stationed at the Institute has risen from five to forty, and the annual income from £8,000 to approximately £25,000, apart from a yearly grant by the Australian Commonwealth Council for Scientific and Industrial Research for the maintenance of its Division of Soils, which has its headquarters at the Waite Institute. After thirteen years of eminent service, Prof. Richardson has now resigned to occupy the position of Deputy Chief Executive Officer of the Council for Scientific and Industrial Research, and Prof. Prescott has been appointed director of the Waite Institute.

Prof. Richardson is a graduate of the University of Adelaide and was acting director of agriculture in South Australia in 1911. From 1911 until 1924 he was superintendent of agriculture for Victoria and visited the United States and Canada to report on agricultural research and education in 1918. From 1919 until 1924 he was director of the School of Agriculture in the University of Melbourne. Prof. Richardson visited South Africa, Europe, America, Japan and Java in 1926 and was a delegate to the Imperial Agricultural Research Conference at London in 1927. He was appointed a member of the Executive of the Australian Council for Scientific and Industrial Research in 1927, shortly after its inception in 1926, and was official agricultural adviser to the Australian delegation to the Imperial Conference at Ottawa in 1932. He was elected first president of the Australian Institute of Agricultural Science, which was established in 1935.

Prof. Prescott is a native of Lancashire and graduated in chemistry at the University of Manchester. In addition to post-graduate experience at Manchester, he worked at Rothamsted Experimental Station with Sir John Russell and at the University of Leipzig with Dr. Wolfgang Ostwald. From 1916 until 1923 he was chief chemist to the Royal Agricultural Society of Egypt and superintendent of field experiments at the Society's Experimental Farm at Bahtim. His work in Egypt concerned problems of soil fertility associated with Egyptian agriculture and the manuring, spacing and irrigation of wheat, maize and cotton.

In 1929, Prof. Prescott was appointed chief of the Division of Soils of the Council for Scientific and Industrial Research at the Waite Institute. His work in Australia has related chiefly to the classification and geographical distribution of soils, and his bulletin on the soils of Australia, published in 1931, has become a standard reference book throughout Australia. Prof. Prescott has travelled extensively in Australia and New Zealand and is familiar with agricultural and pastoral conditions in all the Australian States and the Northern Territory. He was federal president of the Australian Chemical Institute in 1936–37.

The association of Richardson and Prescott over the first thirteen years of the Waite Institute has proved of immense value to agricultural science in Australia.

Science News a Century Ago

The Royal Institution

THE anniversary meeting of the Royal Institution was held on May 1, 1838, Benjamin Bond Cabbell in the chair. The report of the visitors showed that the income of the Institution for the year exceeded the expenditure by £140. An endowment of £1,000 in three per cent Consols had been made by Mrs. Acton, of Euston Square. Repairs and improvements to the buildings had cost £1,853. Courses of lectures then being given or soon after to commence were those on geology by John Phillips, F.R.S., professor of geology in King's College, London; those on vocal harmony—on the English opera—by Edward Taylor, Gresham professor of music; and others on electricity by Prof. Faraday and on botany by Prof. Lindley.

Henry's Investigations on Electrical Induction

"IN 1838, after Henry's return from his first visit to Europe, he discovered an entirely new class of phenomena in electrical induction; and as the field was entirely his own he entered into this work with great enthusiasm. In these researches he extends greatly our knowledge of electrical induction. He first showed that an induced current may excite a second induced current in a neighboring closed conductor, and this last may induce a third current in another neighboring closed circuit and so on. These various induced currents Henry styled currents of the first, second, third, fourth, fifth, &c., orders. He shows that these currents alternate in their directions in the successive orders,—at least when these currents are induced by the discharge of a voltaic battery. He investigates the differences in the properties of these currents according as they flow through conductors formed of few convolutions of low resistance or through many convolutions of high resistance. . . . These researches into the nature and laws of the induced currents of different orders are the most finished of Henry's works and will ever be regarded as models of careful and thorough scientific work" (A. M. Mayer).

The first account of Henry's experiments was given by him in a letter read to the American Philosophical Society on May 4, 1838, entitled "A Letter on the production directly from ordinary Electricity of Currents by Induction, analogous to those obtained from Galvanism".

The Ornithological Society

AT a meeting of the Ornithological Society held on May 5, 1838, J. R. Gowen being in the chair, the report of the Council was read. In this it was stated that the Commissioners of Her Majesty's Woods and Forests had caused some ponds and shallows to be made in the islands in St. James's Park, in compliance with a request made to them by the Council. Mr. Blyth then exhibited specimens of three wild British geese allied to the domestic breed, namely, the grey goose (*Anser cinereus*), the bean goose (*A. segetum*) and the white-fronted goose (*A. albifrons*), all of which are promiscuously sold in the markets under the general name of 'wild geese'. The first of them was stated to be the primitive stock of the domestic goose, and to have become of exceedingly rare occurrence in the British Islands, although it formerly bred plentifully in the Fens. Until very recently, no specimen of it existed, that he could learn of, in any of the London museums; but aged examples of the bean goose, that had the terminal *nail* of the beak white, were commonly ticketed with its name. During the severe weather of the preceding winter, thousands of bean geese were brought to market. Though it had never heretofore been known to breed when domesticated, it was stated that two females were then incubating upon one of the islands in St. James's Park.

Hancock's Steam Gig

UNDER the heading "Steaming Extraordinary" the *Mechanics' Magazine* of May 5, 1838, said: "Yesterday afternoon Mr. Walter Hancock, the enterprising steam carriage engineer, accompanied by two friends, rode from Stratford, and through the principal streets of the city in a steam gig. Mr. Hancock remained a considerable time with this novelty of science in front of the Guildhall, now and then guiding it adroitly around the open space. . . . Everyone seemed surprised at the ease with which Mr. Hancock threaded his way through the crowd of carts, omnibuses, cabs and other vehicles in Cheapside, Leadenhall Street and other crowded thoroughfares. The gig stopped opposite the bank for a few minutes, when the machinery was inspected by Mr. Oldham, the engineer who has fitted up all the printing apparatus of that establishment to be worked by steam."

University Events

LEEDS.—Prof. Mouat Jones, of Manchester, has been appointed vice-chancellor, in succession to Sir James Baillie, who retires under the age limit. Prof. Jones, who was born in 1882, has been for seventeen years principal of the Manchester College of Technology, in addition to being dean of the Faculty of Technology of the University of Manchester.

LONDON.—The following doctorates have been conferred: D.Sc. in zoology on Miss D. R. Crofts, a recognized teacher at King's College of Household and Social Science; D.Sc. (Engineering) on Mr. W. B. Pollard, an internal student, of the Imperial College—Royal School of Mines.

ST. ANDREWS.—The Senatus Academicus of the University has resolved to confer the honorary degree of LL.D. on the following, among others: Prof. E. D. Adrian, Foulerton research professor of physiology and fellow of Trinity College, University of Cambridge; Prof. R. G. Collingwood, Waynflete professor of metaphysical philosophy and fellow of Magdalen College, University of Oxford; Dr. W. H. Fyfe, principal of the University of Aberdeen; Dr. A. D. Lindsay, master of Balliol College and vice-chancellor of the University of Oxford; Dr. R. T. McKenzie, emeritus professor of physical education in the University of Pennsylvania; Sir Gilbert Morgan, head of the Chemical Research Laboratory, Teddington; the Marquis of Willingdon, Viceroy and Governor General of India, 1931–36.

Societies and Academies

London

Royal Society (*Proc.*, A., **165**, No. 921, April 5).

HAROLD JEFFREYS: Significance tests when several degrees of freedom arise simultaneously.

P. A. M. DIRAC: A new basis for cosmology.

P. M. S. BLACKETT and J. G. WILSON: The scattering of cosmic ray particles in metal plates.

R. J. SCHMIDT and O. A. SAUNDERS: Motion of a fluid heated from below.

E. GLÜCKAUF and F. A. PANETH: Identification and measurement of helium formed in beryllium by γ-rays.

J. W. J. FAY, E. GLÜCKAUF and F. A. PANETH: Occurrence of helium in beryls.

M. H. L. PRYCE: The neutrino theory of light.

W. C. PRICE and Miss D. M. SIMPSON: Absorption spectra of sulphur dioxide and carbon disulphide in the vacuum ultra-violet.

M. BORN: A suggestion for unifying quantum theory and relativity.

D. A. JACKSON and H. KUHN: Hyperfine structure, Zeeman effect and isotope shift in the resonance lines of potassium.

Paris

Academy of Sciences, February 28 (*C.R.* **206**, 633–704).

GUSTAVE CHOQUET: The prolongation of homeomorphs.

MARCEL BRELOT: The extensions of *balayage*.

FRANÇOIS LEJA: Certain extremal rational functions.

HUBERT DELANGE: Certain categories of series of polynomials.

BERNARD KWAL: A generalization of the variational principle and of the canonical equations of Hamilton. Application to the relativistic theory of corpuscular assemblies.

MARCEL SÉDILLE: The development in series of the movement round an aeroplane wing placed in any field whatever.

ROBERT D'ADHÉMAR: The theory of the gyroscopic movement of projectiles. The indeterminations.

BERNARD LYOT: Observations of the solar corona and the prominences made at the Pic du Midi during 1937. 240 hours observations under the best conditions were available. 125 spectra and 13 direct photographs of the corona were taken, and 60 metres of kinematographic film showing the movements of the prominences. A preliminary discussion of the results is given.

MARCEL MATRICON: Application of the method of the self-consistent field to atomic nuclei.

J. GÉHÉNIAU: Spherical waves in the wave mechanics of the photon.

JEAN VILLEY: A method for the measurement of the adiabatic compressibility of liquids.

RENÉ LUCAS: Longitudinal waves of very high frequency in viscous fluids.

MAURICE DODERO: The preparation by electrolysis at a high temperature of metallic phosphides, in particular, of the manganese phosphide MnP. Fused mixtures of manganese chloride, sodium metaphosphate and an alkaline chloride give manganese phosphide, MnP, capable of isolation in crystalline form and giving theoretical figures on analysis.

MLLE. MARGUERITE QUINTIN: The radius of the copper ion in solutions of the benzene-sulphonate.

CHARLES F. SQUIRE: The diamagnetic anisotropy of an aromatic molecule.

GEORGES SIMON and JEAN BOUCHARD: The influence of a transversal magnetic field on the thermoelectric power of nickel and of various ferronickels submitted to traction.

MME. ZINA SOUBAREW-CHATELAIN and ALAIN BERTON: The ultra-violet absorption spectra of the system MoO_3—NaOH in dilute solution. The conclusions previously drawn from the study of the variations in the electrical conductivity of solutions of molybdic acid during neutralization with alkali are confirmed by the study of the absorption spectra.

PAUL RUMPF and FÉLIX TROMBE: A free radical of a new type. The paramagnetism of tritolylammenium perchlorate. If the ammenium cation exists in the monomeric form, it is true free radical, a compound with an odd number of electrons, and, according to G. N. Lewis, should be paramagnetic. Tritolylammenium perchlorate is now shown to be paramagnetic.

MLLE. SUZANNE THÉVENET: The influence of a given electrolyte on the viscosity of an arsenic sulphide sol at different stages of its evolution.

AUGUSTIN BOUTARIC: The application of the dilatometric method to the study of colloidal gels. The expansion of resinous products is related to the quantity of water present in the sample. Only thoroughly dried samples give an increase of length which is proportional to the rise of temperature.

LOUIS MEUNIER and GEORGES VAISSIÈRE: The polymerization of vinyl acetate.

MLLE. FRANCE BLOCH: On thioacids. Discussing the two possible constitutions for thioacids, R.CS(OH) and R.CO(SH), the latter is regarded as in better agreement with experimental facts.

CONST. ZENGHELIS and MLLE. CATHERINE STATHIS: Catalytic hydrogenations by colloidal rhodium. Colloidal rhodium is a hydrogenation catalyst much more powerful than other precious metals. It reduces the carbonyl group easily at ordinary temperature and pressure. Aniline is reduced to ammonia and cyclohexane.

HENRI WAHL: The synthesis of 9-methoxy-5-keto-5, 6, 7, 8-tetrahydrophenanthrene.

JEAN CUVILLIER: The discovery of lepidocyclines in the Oligocene of Egypt.

GEORGES DEFLANDRE: The microplankton of the Jurassic seas preserved in the state of organic matter in the marls of Villers-sur-Mer.

MLLE. MADELEINE FOURCROY: The mode of reduction of convergents.

DANIEL DANIELOPOLU and ION MARCOU: The action of adrenalin on the coronary vessels and the general circulation after the injection of diethylaminomethylbenzodioxan (883 F.).

RENÉ GUY BUSNEL: The influence of the food regime on the biochemistry and the biology of *Leptinotarsa decemlineata* in the fully developed insect. The action of *Solanum demissum* and of the hybrids of this plant.

PAUL WINTREBERT: The ring of mitogenetic induction of the amphibian egg and bipartite gastrulation.

ALBERT BERTHELOT and MLLE. GERMAINE AMOUREUX: The formation of 3-indol-acetic acid by the

action of ultra-violet radiation on tryptophane. Indol-acetic acid is formed by the action of light of wave-length less than 2900 A. on very dilute solutions of tryptophane.

ALBERT DEMOLON and ANTOINE DUNEZ: Agronomic observations on the bacterial symbiosis of the Leguminosæ.

Brussels

Royal Academy (*Bull. Classe Sci.*, **23**, No. 12; 1937).

E. DE WILDEMAN: Abortion of the ovaries in some phanerogams (2).

A. BAUDET: Cyclic homography of space of period five and on some birational transformations deducible from it.

TH. DE DONDER: Velocities of reaction. A general thermodynamical treatment based on the author's previous treatment of affinity.

V. WILLEM and R. BOCLAERT: Respiratory manœuvres of *Periophthalmus*.

M. G. E. COSYNS: Study of the specific primary ionization due to cosmic radiation. The particles constituting the soft and hard groups of cosmic rays are of different kinds, since the specific primary ionization is different for the two groups.

TH. DE DONDER: Affinity, velocity of reaction and power.

H. DE WINIWATER: Determination of sex.

Sydney

Royal Society of New South Wales (**71**, 1937).

J. A. DULHUNTY: (1) Notes on the stratigraphy and physiography of the Talbragar fish-bed area. This area lying to the west of the Main Divide between Cassilis and Mudgee, exhibits a plateau at 1,700 feet in which mature topography was developed prior to the late tertiary basalt flows. The plateau falls to the west merging with the western plains, the headquarters of the western rivers showing no late Tertiary rejuvenation. The Main Divide is almost imperceptible, being determined by an anticline which has up-warped the plateau surface. The area is occupied by an east-west trough which lagged behind during the Kosciusko Epoch. The stratigraphical sequence is complete from Mid-Kamilaroi to Lower Jurassic, exhibiting well-defined units. The chert of the fossil fish-beds forms an isolated mass occurring 30 feet above the base of the Jurassic. (2) Stratigraphy and physiography of the Goulburn River district. The area concerned is that drained by the Goulburn River. A plateau at 1,600 feet is dissected by mature valleys which post-date tertiary Alkaline Intrusives but pre-date late Tertiary Basalts. The streams show a general absence of epi-tertiary rejuvenation, and the Goulburn River occupies the axis of a tectonic trough which lagged behind during the Kosciusko Epoch. Contrasting valley types exemplify marked geological control of topographical development. Low anticlines, pitching to the north, form predominant structures which have produced undulations in the plateau surface. Kamilaroi strata are followed by Triassic Sandstone, which is separated from Lower Jurassic Sandstone by a well-marked horizon of clay shales.

H. G. RAGGATT: Occurrence of glendonites in New South Wales, with notes on their mode of origin. Glendonites are believed to have formed under cold conditions on the floor of shallow and more or less isolated basins. Their alternation with calcareous concretions suggests alternation of cold (glauberite decomposition) and warm (calcium carbonate deposition) conditions. The occurrence of 'glendonites' and calcareous concretions in the Cretaceous offers confirmation of views reached from consideration of the Permian.

A. R. PENFOLD and J. L. SIMONSEN: Constitution of a phenol isolated from various Australian essential oils by Penfold and Morrison (*J. Proc. Roy. Soc. N.S.W.*, **56**, 87; 1922). This substance, for which the name 'Bæckeol' is proposed, has melting point 103°–104°, and molecular formula $C_{12}H_{16}O_4$. It crystallizes in yellow prisms. Bæckeol contains two methoxy groups and one hydroxy group giving a monoacetyl derivative, m.p. 71°–72°.

A. BIRCH: Structure of origanene. (1) This paper describes the isolation of origanene in a state of approximate purity from commercial α-phellandrene, and the preparation of a number of characteristic derivatives. The evidence shows that the substance is distinct from any known terpene, and is probably bicyclic, with one double bond. Much of the published work on origanene is shown to be erroneous, many of the results obtained being probably due to the presence of impurities.

A. R. PENFOLD and F. R. MORRISON: Essential oils of *Eucalyptus australiana* (Baker and Smith) and its physiological forms (2). Essential oils obtained from *Eucalpytus australiana* (Baker and Smith) growing in Victoria. The yield and chemical composition of the essential oils examined differed considerably from those obtained from New South Wales (*J. Roy. Soc. N.S.W.*, **49**, 111; 1935). The principal constituents identified were *l*-α-phellandrene and piperitone 32–52 per cent and piperitol (the principal constituent of New South Wales trees is cineol 70 per cent). The yield of oil varied from 0·4 to 1·8 per cent, very much lower than that obtained from *E. australiana* in New South Wales, namely, 3 per cent.

G. D. OSBORNE: Some major geological faults north of Raymond Terrace and their relation to the structure of the Stroud–Gloucester Trough. The Williams River Fault and the Tarean Fault which break through the Upper Palæozoic rocks north of Raymond Terrace are shown to have interesting structural relations with the Stroud–Gloucester Trough, a remarkable, narrow basin which runs more or less meridionally from Gloucester southward towards Stockton. Evidence is given of the former being the older of the two faults and connected with an early phase of the Late Palæozoic diastrophism while the Tarean Fault is regarded as of epi-Newcastle age.

J. G. CHURCHWARD: Studies on physiological specialization of the organisms causing bunt in wheat and the genetics of resistance to this and certain other wheat diseases (1). Physiological specialization studies. Four wheat varieties which acted as differentials when inoculated with spores and grown in Australia and the United States separated out four physiological races of *Tilletia levis* and three of *T. tritici*. Biometrical analysis and studies of the shape, size and consistency of the bunt balls of the seven different races did not show any constant differences. Studies in the constancy of reaction, in different seasons, of bunt collections showed that some give a constant reaction while others vary within limits set by environmental conditions.

Forthcoming Events

Monday, May 2

ROYAL INSTITUTION, at 5.—Annual Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Lord Moyne: "Travel Films in Kodachrome from Greenland to Rio."

Tuesday, May 3

ROYAL SOCIETY OF ARTS (INDIAN SECTION—DOMINIONS SECTION), at 4.30.—Dr. R. Maclagan Gorrie: "The Problem of Soil Erosion in the Empire with Special Reference to India".

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Frank Smith, F.R.S.: "Disorderly Molecules and Refrigerating Engineering" (James Forrest Lecture).

Wednesday, May 4

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. S. J. Truscott: "Metal Mining Enterprise" (Warrington Smyth Memorial Lecture).

INSTITUTE OF METALS (at the Institution of Mechanical Engineers, Storey's Gate, S.W.1), at 8.—Prof. G. I. Taylor, F.R.S.: "Plastic Strain in Metals" (Annual May Lecture).

Thursday, May 5

CHEMICAL SOCIETY, at 8.—Prof. J. Masson Gulland: "Nucleic Acids".

Friday, May 6

ROYAL INSTITUTION, at 9.—Dr. H. W. Melville: "The Nature of Chemical Reactivity".

ERRATUM.—Entries referring to meetings of the Institution of Civil Engineers, the Chemical Society and the British Psychological Society were inadvertently inserted in this column last week. The announcements were incorrect.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANTS (grades II and III) to the War Department Chemist—The Under-Secretary of State (C.5), The War Office, Whitehall, London, S.W.1 (April 30).

ASSISTANT (grade II, engineering—ref. *B*. 33), ASSISTANT (grade II, test methods—ref. *B*. 34) in the Directorate of Technical Development, Air Ministry, Adastral House, Kingsway, W.C.2—The Secretary (S.2.D) (May 6).

ASSISTANTS (grade I—ref. 13 O), (grade II—ref. 14 O) at the Royal Aircraft Establishment, South Farnborough, Hants (May 6).

LECTURERS IN BIOLOGY, PHYSICS, MATHEMATICS, BUILDING SCIENCE, AND CHEMISTRY in the South-West Essex Technical College and School of Art, Forest Road, Walthamstow, E.17—Mr. E. H. Finch, 283 High Street, Walthamstow, E.17 (May 7).

CHEMIST in the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (May 7).

ASSISTANT LECTURER IN AGRICULTURAL ENGINEERING in the University of Leeds—The Registrar (May 12).

LECTURER IN MATHEMATICS in the Heriot-Watt College, Edinburgh—The Principal.

COUNTY ADVISER IN HORTICULTURE in Buckinghamshire—The Agricultural Organizer, County Offices, Aylesbury.

VICE-PRINCIPAL of Chadacre Agricultural Institute, Bury St. Edmunds—The Principal.

TEACHER OF CHEMISTRY in the Polytechnic, Regent Street, London, W.1—The Director of Education.

LECTURER IN HORTICULTURE in the University of Reading—The Registrar.

ASSISTANT LECTURER IN SOCIAL PSYCHOLOGY and ASSISTANT LECTURER in STATISTICS in the London School of Economics, Houghton Street, Aldwych, London, W.C.2—The Secretary.

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